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ELECTRIFYING SUB-SAHARAN AFRICA: DOING BUSINESS AT THE BOTTOM OF THE
PYRAMID MARKET IN THE SOLAR ENERGY SECTOR

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Abstract

Africa GreenTec is an Independent Power Producer, serving households, communities, and businesses in sub-Saharan Africa by offering affordable solar energy solutions. A case study closely examines Africa GreenTec's approach toward opening up the African market to solar energy and its distinct approach and challenges. A two-stage model developed in an evaluation report has been devised to choose the most potential countries for expansion amid political instability. The strategy taken by Africa GreenTec to meet the needs of the Bottom of the Pyramid market will be closely examined in the teaching note that follows, with numerous theories and concepts being applied.

Keywords

NGO, Entrepreneurship, Mini-Grids, sub-Saharan Africa, Solar Energy, Market Expansion, Renewable Energy, Diversification, Political Instability, Impact, Sustainable Development, Bottom of the Pyramid Market, SDG, Social Enterprises

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Table of Contents

1.	Case Study: Electrifying sub-Saharan Africa.....	3
2.	Evaluation Report.....	23
2.1.	Introduction	23
2.2.	Situation Analysis: Geographical Expansion.....	24
2.3.	Evaluation Purpose and Background	25
2.4.	Literature Review	26
2.5.	Research Question.....	34
2.6.	Methodology	35
2.6.1.	Purpose	35
2.6.2.	Qualitative Research.....	36
2.6.3.	Quantitative Research.....	39
2.7.	Findings.....	40
2.8.	Pre-Selection	43
2.9.	Stage 1: High Potential Country Selection Analysis Results	44
2.10.	Stage 2: Recommendations and Implementations in Light of Political Risk.....	47
2.11.	Sensitivity Analysis.....	61
2.12.	Limitations	61
2.13.	Conclusion.....	62
3.	Teaching Note: Business Strategy at the BoP Market	64
	References	74
	List of Figures	80
	Appendices	81

1. Case Study: Electrifying sub-Saharan Africa

Africa GreenTec – Rural Development through Renewable Energy

At the end of 2022, after an exciting but also challenging year for the for-profit NGO, Torsten and Aida Schreiber, the two founders, were looking back at the company's achievements. Within the last couple of years, the couple had built a successful business in the renewable energy sector in sub-Saharan Africa (SSA). From its founding in 2016, with a seed funding of half a million euros, the company had grown into a big player, providing access to electricity to many communities in SSA. The team had successfully secured funding to realize multiple projects, allowing Africa GreenTec (AGT) to enter countries including Mali, Niger, Senegal, and Madagascar (see Appendix A). Although the team had been able to implement many ImpactSites, enabling communities to gain autonomy through electrification, the two founders were considering the company's next steps. In a recent meeting, the team reviewed its financial statements as recent projects lacked sufficient funding, raising concerns regarding AGT's commercial viability. Although the company had successfully implemented 25 ImpactSites, the nature of the projects had not allowed the company to become profitable. Securing future funding and commercial viability while creating impact posed a crucial challenge.

After careful consideration, the team looked at potential ways to ensure AGT's profitability in the next few years. Looking at the evolving market and landscape, Wolfgang, the company's chief operating (COO) and financial officer, proposed two new business units, namely, a Commercial & Industrial (C&I) and Residential business unit. The company's entrepreneurial spirit and opportunistic stance had allowed AGT to build a successful business model in the past, leveraging its close ties to government representatives and stakeholders in the countries. Torsten

and Aida were concerned whether this strategic move would be the right way to secure future profitability or whether the focus should remain on expanding the current business operations of ImpactSites in rural areas. Moreover, the political risk associated with operating in SSA affected the success of several projects in the past. The two founders and the team were considering two options, and together they had to decide in which direction AGT should head.

Sub-Saharan Africa: The Energy Crisis and Its Opportunities

The predominant method for providing electricity to rural villages in SSA involved the use of old diesel generators. This approach was considered unsustainable due to its dependence on fossil fuels, especially diesel, leading to substantial contributions to air pollution and greenhouse gas emissions. Moreover, the energy crisis in SSA had a profound impact on both rural and urban areas. In rural regions, the limited access to reliable electricity not only hindered economic activities but also drastically reduced the quality of life for residents, posing severe health risks. The challenges were exacerbated by the difficulty of establishing centralized power grids due to remote locations and sparse population density. Additionally, the absence of infrastructure for renewable energy solutions further limited the adoption of cleaner alternatives, perpetuating a cycle of energy insecurity. In urban areas, the dependence on centralized power grids led to frequent outages, disrupting daily life, and hindering businesses. The high population density intensified the demand for electricity, straining existing infrastructure and resulting in increased air pollution. The use of backup generators during power shortages not only posed health risks but also added to the environmental burden. Moreover, the challenges of implementing decentralized renewable energy solutions in urban areas were amplified by limited space and complex landscapes. Africa had seen tremendous population increase and GDP growth over time, establishing the continent as a center of development. According to projections, SSA was predicted to host 25% of the world's

population during the next thirty years (IMF 2023). But the expected increase also brought along problems in terms the underlying energy infrastructure. AGT realized the potential of SSA and observed that the region had a surplus of energy resources because of its ideal environment and high solar radiation levels. These characteristics highlighted SSA as an area full of opportunities and made it an excellent choice for AGT's entry into the energy sector. 600 million people, approximately 53 percent of the region's population, lived without access to electricity in SSA, hampering educational and economic opportunities (UNCTAD 2023, 2).

Building a Self-Sufficient Ecosystem: The First Solartainer

Back in 2014, Torsten and Aida were on their way to the village Mourdiah in Mali together with their team, marking the very beginning of AGT. The government of Mali had asked them to take on a pressing challenge: providing electricity to a nation almost three times the size of Germany, suffering from inefficient access to electricity. The couple had the opportunity to visit the country's largest diesel power plant, that supplied Bamako with electricity. During this trip, the *Malian Ministry of Energy and Water* requested the couple to build a strategy that would bring electricity to the country and substitute 20MW diesel power plant which used on average 140,000 liters of fuel per day. Discovering that the city's electricity relied solely on this technology was concerning. This visit became a decisive turning point and their idea was clear; providing energy to at least 3 million people in Africa within the next ten years. Target customers of AGT's solutions were households, SMEs, social institutions, and farmers in rural areas with no prior access to electricity or highly dependent on diesel generators. Moreover, in the context of climate change, their initiative had to be sustainable, hence the choice of solar power posed the perfect solution in an environment of solar abundance. The solution was not to create a business model that would only be profitable to AGT but also to the population in the long run. AGT's mission became the

empowerment of people to achieve more self-determination and growth, triggering economic development in rural areas through sustainable energy solutions. The team partnered with the president of Mali at the time, Diankounda Traoré, with the goal to find the perfect location for the first pilot project. Using equity capital and crowd loans, the first prototype was built out of a 20-foot shipping container in 2015. With no prior experience of the conditions, they were bound to operate in, the determination was high to successfully integrate the first off-grid impact site.

At first, AGT provided villages with electricity through its core product, the Solartainers, a modular solar power plant integrated into a mobile freight container. The Solartainer was introduced to several communities and was quickly accepted as a viable solution by communities. The first Solartainers were financed through crowdfunding campaigns, which proved to be highly successful, with the first container being financed in only three days. Pure investment also played a huge role in the financing. At the time, AGT had one product, the Amali Solartainer, creating one main revenue stream. However, Torsten quickly realized that electricity only would not allow AGT to operate profitably in rural areas in Africa, as the cost to build the complete electricity network was high. It quickly became evident that economies of scale needed to be achieved for small grids to be profitably. AGT searched for further revenue sources to refine electricity and create more value to the communities. The team decided to diversify their product line by operating as a supplier for basic infrastructure such as electricity, water, cooling systems and internet, serving a broader spectrum of needs.

New Potentials: ImpactSites

The following year, AGT gained popularity in the industry. The project caught the attention of Dr. Wolfgang Rams who saw great potential in AGT's projects but who had a different

approach to the business. Wolfgang Rams and Torsten met after AGT won a program in Germany with the idea of mobile solar power plants. After a trip to Mali together with Torsten in December 2018, Wolfgang decided to take part in the operational management of the company. As the new Chief Financial Officer of AGT, Rams brought professional knowledge from the business and corporate world into the company. Rams had a different, yet complementary vision to Schreiber's for the company. Indeed, Schreiber's ambition was to provide electricity to rural areas in Africa, hence the creation of the Solartainers. However, Wolfgang quickly understood that diversification would be key to the expansion of the company. Electricity was only the first step in increasing productivity in villages. Thus, came to mind the idea of the ImpactSites, which were composed of Solartainers, the core product, and additional services, creating an entire ecosystem that could be offered to communities. The LinkUP offered WiFi service for the villagers, PumUP provided an irrigation system, StreetUP grants streetlight and lastly, CoolUP as a fridge (all PV powered). The ImpactSite combined energy-efficient technology for internet connection, water treatment and cooling with intelligent mini-grids for sustainable power production and distribution. The growth in product portfolio had benefitted both AGT and its customers as it responded in more depth to the problematic of isolation of rural zones. The close collaboration with the communities living in these rural areas, allowed the team to learn about the needs and demands of the market. Therefore, the ImpactSites came from a sustainable point of view, acknowledging that access to electricity would not be enough for villages to develop in the long term.

Business Model and Company Structure

The growing portfolio of products had opened the possibility for AGT to structure its business model in three ways – as a *System Provider*, *System and Financing Provider* (Leasing Model), and *Utility Provider* (see Appendix B). Within the *System Provider Model*, AGT sought

to provide a wide range of services such as engineering, procurement, construction, and the maintenance of solar systems. This model allowed the company to establish a primary revenue stream from direct sales of the product or system to end-consumers. The second business model, the *Leasing Model*, had been deployed the most, being able to respond to the low purchasing power of communities and governments. AGT served as both system and financing provider, offering the option to lease solar solutions, presenting clients with the flexibility to access and transition to solar solutions without an initial upfront capital investment. Revenue was primarily generated through leasing fees as well as service and maintenance charges. The third model positioned AGT as a *Utility Provider*. Through local country subsidiaries, AGT offered end-to-end solar solutions for customers. This meant handling all aspect from engineering, procurement, and construction, all the way to service, maintenance, and operations. AGT's operation of the solar system on behalf of the client allowed revenues to come from service charges and impact monetization. This model allowed constant configurations and add-on services were not limited to electricity provision but could be extended through Cooltainer, Watertainers, or Solarbakeries. As a *Utility Provider*, the company had the possibility to reach rural communities combating energy poverty while fostering socio-economic development in the continents most marginalized communities. In line with the business models, the company was set up as a public company. The Africa GreenTec AG, as the holding company had been thereby established to supervise and manage the team of engineers, financiers, market intelligence researchers and technicians, ensuring successful local operations. AGT AG's affiliated companies within the sub-Saharan African region were put in place to carry out the ImpactSites activities thereby taking care of the local operations and maintenance of the projects. By cooperating with private companies such as technology suppliers and local governments, the team was able to improve local renewable energy policies and strategies,

achieving rural electrification targets while pushing the development of sustainable off-grid villages.

The company had been generating profits through five different channels depending on the underlying business model. First and foremost, the products and accompanying equipment were sold at a margin to subsidiaries or third parties. Second, service and maintenance fees in the case of AGT being the *System Provider* with the customer having complete ownership. Third, the sales of electricity, water, internet, and cooling services. Fourth, AGT received margins from providing the necessary funding as for example the case with crowdfunding. Finally, medium to long-term dividend payment from subsidiaries made up another channel.

Africa GreenTec's Financial Wheel

In April 2020, AGT entered the crowdfunding market by introducing its platform as an alternative to bank loans. This strategic decision aligned with the growing trend of equity-based crowdfunding also known as crowd investing in Germany. AGT has made an impact by becoming the first German company to launch a crowd investing campaign for an African project. Their innovative strategy revolved around a business model; selling Solartainers priced at around 150,000 euros each along with the electricity they produced to rural communities. Recognizing the purchasing power in these areas, AGT established an operating company that financed the acquisition of Solartainers and subsequently sold electricity back to the community. Notably a substantial portion of AGT's funding came from crowdfunding allowing for participation and support for this energy initiative. AGT introduced a financing approach that included integrated profit participation rights, giving backers a chance to directly engage with the company and have a share in its success. These profit participation rights, like loans, acted as a form of capital that

combined elements of debt and equity with flexible contractual terms. The goal behind this instrument was to attract supporters from backgrounds who were interested in investing. They were committed to ensuring that their initiatives were not exclusively supported by investors. AGT welcomed investors who could contribute little as 250 euros. These individuals also had the opportunity to become fledged members of the company aligning their long-term support, with benefits and contributing to the growth of the firm.

AGT actively embraced crowdfunding to involve individuals in projects. This approach appealed to investors who were specifically interested, in project focused opportunities and are willing to take on risks. This approach fostered a group of investors and supporters with the possibility for them to eventually become shareholders of AGT AG. Benefits include securing funding for projects, promoting marketing initiatives and building assets in a market. When it came to financing assets, AGT utilized a range of instruments with an emphasis on debt capital due to the flexibility of assets that could be pledged. Initial assets were financed through crowdfunding and in 2018 AGT issued a bond that raised 6.5 million euros from investors. These funds were specifically allocated to support AGT's subsidiary in Mali with AGT Asset GmbH maintaining an 85% ownership stake to ensure access, to financed assets. To attract funding exceeding 100 million euros and demonstrate impact aligned with the SDGs, AGT pursued a fund approach. The different stages involved in providing components and systems generated returns while the stage of operating the plant required a longer-term perspective. Decisions regarding where to allocate funds into equity, debt and grants were made after consideration. Grants primarily finance grids and house connections covering 30% of the financial requirement. These funds were sourced from development banks. Around 50% of the requirement was funded through debt capital, which mainly supported assets that generated revenue and could be reallocated if a village was non-

functioning. This helped mitigate investor risk. The remaining 20% of the requirement was covered by equity capital, which was directed towards establishing country companies. This included investments in staff training, sales operations, maintenance activities and infrastructure provision.

A Pivotal Event: Struggles in Chad and Niger

Despite the great business idea that AGT had been working on, the company had to contend with several setbacks, with one of the most significant being the political instability in some of the operating countries. Disrupting the initial plans of the startup in their quest for sustainable growth, political instability played a significant role in the company's challenges in countries where operations did not unfold as anticipated. AGT had not been treating political instability as a primary criterion for entering new markets. However, it has been part of the company's strategy to avoid volatile nations and unstable territories. Nevertheless, when operating in SSA countries, there is no guarantee of maintaining stability, particularly as countries facing significant financial problems may experience a sudden escalation of tensions. In the market selection process AGT included a preliminary market assessment as a first step, where the company studied indicators on the socioeconomic, competitive, political and security market environment, and the country's current energy supply. AGT had also approached local authorities to initiate market integration and cooperation with the government.

Consequences of Political Instability

Political instability had significant repercussions on AGT. It disrupted their operations, leading to delays and added costs. Security risks in politically unstable regions posed challenges, necessitating increased resources. Regulatory changes added uncertainty and complexity to their business. Economic instability impacted AGT's financial stability, with restricted access to

funding. These challenges could have made it more challenging to attract investors and partners. In addition, human capital recruitment and retention proved more difficult, leading to project delays and opportunity costs. It also pushed the company to hold operations in countries like Niger and to completely stop operating in Chad in the past.

Niger

Operations in Niger started in 2017 in the village of Amaloul for AGT. The village was located far from the power grid and only had a few thousand inhabitants. The project aimed to implement a power grid made entirely of renewable energy; solar panels were applied successfully as 150 families benefited from the electricity grid. Amaloul's promising development, AGT had the opportunity to further expand their work with 50 more villages in Niger. They did so by signing a Memorandum of Understanding (MoU), with the government. To carry out their expansion, AGT surveyed the village of Amaloul on their satisfaction with the Impact Site. However, in the past years Niger did face economic difficulties and security issues. Indeed, the presence of the terrorist group, Boko Haram, in Western areas including Niamey and the South-East border rose the insecurity. However, in early 2017, the core operations within Sambisa Forest of Boko Haram collapsed. According to a report by The Quint (2017), the region experienced merely four occurrences of Boko Haram activity since the onset of 2017. Among these, a significant defeat inflicted by the Nigerien armed forces stands out, resulting in 57 Boko Haram casualties in Gueskerou during April. Throughout Issoufou's second term, the menace posed by Islamic extremist groups persisted. In response, Niger collaborated with Burkina Faso, Chad, Mali, and Mauritania in 2017 to establish the G5 Sahel Joint Force, a regional anti-terrorism initiative. (Center for Strategic and International Studies 2017.) Despite these efforts, attacks endured, primarily due to insecurity along Niger's border regions. Regardless of this continuous turmoil,

Issoufou managed to implement policies during his two terms that bolstered the economy. This marked only the onset of the political instability that Niger had been grappling with. Following the election of President Bazoum in 2021, instability escalated as people began to revolt against a government closely aligned with the French government. Subsequently, a coup further plunged the country into total chaos. All this had AGT reconsidering their operations in the country as the companies had to hold down several operations, however the company has kept two of their impact sites running despite the highly volatile situation.

Chad

In 2021, the partnership between Chad and AGT began following a request from the head of state and the energy minister. As stated by the Chad project lead, AGT's role was to implement a new strategy aimed at transitioning the country away from diesel generators. The company was contracted to establish power generation sites capable of supplying electricity to ten of the largest cities in the country, excluding the capital, N'Djamena. This ambitious project required AGT to construct and manage larger power plants in collaboration with the government. However, this arrangement also carried risks for AGT, as the contractual documents were signed by the Minister of Energy rather than the Chadian government. Unfortunately, these risks materialized when the political situation in the country deteriorated. The entry of Libyan rebel groups into Chadian territory resulted in the assassination of the president, and a notice was issued indicating that the country would get 72 hours to mourn before further attacks would be pursued. Under these perilous circumstances, AGT made the difficult decision to withdraw from the country permanently. While operations had not yet commenced in Chad, the first containers earmarked for the capital were on their way. However, AGT successfully intercepted these containers before they reached the war zone.

Mitigation of Political Instability Risks

AGT had always known that operating in Africa was tricky, so the company selected the ideal locations for their ImpactSites. At the same time, the flexibility of the grids allowed for a rapid dismantling and transfer of the Solartainer and Cooltainer, an ability that helped the company in Niger and Mali. Whenever the team was visiting the operation ground, security measures were in place to ensure a safe and successful mission. With a combination of planning and on-ground expertise the company managed smooth work and adaptability. In 2016, the company was established primarily as a mini-grid developer in Mali, and later expanded its operations to include Niger in 2017. To reduce the entrepreneurial risk, the company was first positioned more broadly geographically, and other more politically stable countries were approached, which included Senegal and Madagascar (both operations started in 2020).

Serving Customers at the Bottom of the Pyramid Market

As a company doing social work presented several challenges in a region as tense as SSA. AGT started with a one-product offer, the Solartainers, before creating the ImpactSite's which opened new doors to the company. Moreover, the technology used for their products was innovative and unique which presented advantages and disadvantages. At that time, there was no competitive nor profitable strategy, the goal was simply to provide electricity to those in need. However, with the arrival of a new eye on the project, Wolfgang, new issues and therefore opportunities were identified. Indeed, in SSA, 30% of the population has no access to clean water and 40% of the fruit a vegetable harvest goes to waste. Therefore, the idea of diversification of the portfolio of AGT emerged. Strategically speaking, AGT diversified its portfolio to reduce risk but to also increase the risk-adjusted rate of return for its investors. Thus, the creation of the Solartainer, Cooltainer and Watertainer and several more products that granted access to basic infrastructures.

In fact, the value creation of AGT was made through the transformation of free solar power into useful services directly via R&D of the final product and its assembling, operation, and remote maintenance. AGT also created value indirectly through marketing tools, brand communication and sales network. Access to infrastructure spurred socioeconomic growth and entrepreneurial activity as it improved opportunities for people, companies and farmers while creating new prospects for future generations. The target investors of the company were thus more focused on RIO (Return On Impact Opportunities) rather than on their ROI (Return On Investment).

Criteria for Market Integration of ImpactSites

AGT undertook several measures before entering new markets. Most of the time, the company was approached by local authorities to initiate market integration as well as cooperation with government. However, for an ImpactSites to be economically viable certain criteria had to be met and were conditioned to sign an MoU. Besides a fifteen-year license covering at least fifty villages, AGT aimed to remain autonomous in terms of moving ImpactSites components between villages. Additionally, AGT necessitated a low-voltage grid which should be provided by government or third parties. Custom duty and import tax exemption benefitting the local subsidiaries and approval of the tariff model provided by subsidiaries were required within the MOU.

Competitiveness in the Energy Market

In the SSA market, the competitive landscape in the renewable energy market had been relatively low but Schneiders believed it to pick up the following years. Nevertheless, the team believed that AGT had entered the market early on leveraging a first-mover advantage with strong local expertise on the ground as well as personal and family ties to its partners. Within the off-grid

electricity market, AGT competed with a few other system providers that could be categorized in three distinct application fields (see Appendix C & D). Pico products had been the most present in SSA but were only able to power smaller low consumption appliances and were usually sourced from low-cost Chinese suppliers. Solar home systems made up the second field and were a stronger power source compared to the Pico systems. However, AGT realized that these systems were not able to meet the threshold to enable productive use, boosting socio-economic development. Hence, AGT leveraged high quality technologies designed in Germany based on their knowledge from on-site research. Looking at the mini-grid market, the company had identified its huge potential alongside other strong players in the market. However, the company believed to have a competitive edge through its holistic approach, offering a variety of products compared to its competitors.

Importance of Strategic Partnerships

The success of social enterprises like AGT also came from their ability to create and maintain strong business partnerships. Indeed, strategically it was vital for AGT to surround itself with important and loyal names in the industry from the early stages. AGT acknowledged that independent sales managers played a critical role in propelling market penetration, AGT offered technology, knowledge, and powerful brand communication, while sales managers added their network in the domestic market. Sales managers were paid on a commission basis, allowing AGT to expand their reach within the market. Therefore, the market entry was faster and the financial costs and risks of AGT were kept low. AGT relied on partnerships with many potential providers of applications, resembling the company to an open platform. AGT partnered with WILO SE, a German pump manufacturer. Partnerships not only improved the products and services offered but also supported marketing efforts in all rural areas.

Insurance against Political Risk

Operating from Germany, a considerable distance from its field operations, AGT faced difficulties due to the lack of direct and reliable information. However, in response to these challenges, AGT developed an internal *Risk Mitigation System*, matching potential risks with tailored mitigation plans. This comprehensive system, managed by risk managers, addressed over 90 potential events across different levels of the company and its subsidiaries. Moreover, the system was regularly updated on a weekly basis to adapt to evolving circumstances. To enhance the risk assessment process, internal information was complemented by updates from external organizations such as the United Nations, local authorities, and the World Bank. This collaborative approach further enriched AGT's understanding of potential risks within the operating environment. AGT strategically employed a decentralized swarm system that distributed operational functions across various locations. This strategic choice effectively minimized the impact of political turmoil by reducing dependence on a single location. Notably, the service's independence from the traditional infrastructure, relying on solar power and local resources, ensured continuity even in challenging political situations. AGT implemented proactive measures to mitigate expropriation risks. By securing guarantees from national and supranational institutions, including the German Government, BMZ, and Euler Hermes, AGT established a safety net. In instances where the resolution of expropriation issues proved complicated, AGT had the capability to swiftly relocate assets to another location, ensuring operational stability within a few days. The company also adopted a multifaceted approach to combat fraud and corruption. The prepayment system for electricity minimized certain types of fraud, while the implementation of smart meters prevented electricity theft. Additionally, the company's bottom-up approach emphasized direct communication with local decision-makers and customers through a dedicated employee at each site. This approach not only deterred potential harm to essential infrastructure but also strengthened

AGT's connection with local communities. Finally, AGT actively collaborated with specialized providers offering risk and crisis management services. These collaborations, alongside partnerships with the German Foreign Office (Embassy) and local security authorities, further expanded AGT's network. This extensive network provided access to intelligence and support crucial for mitigating political and security-related risks. Overall, these strategic connections exemplified AGT's commitment to a comprehensive and well-informed approach to political risk mitigation.

Profitability Hick-Ups

Although AGT had been able to capture a significant share of the market, providing electricity to many communities, impact and profitability had not been increasing concurrently. Wolfgang was concerned, although AGT had been creating immense value, he thought the company was not unleashing its full potential. The ImpactSites had been very valuable in its operations, but the high initial capital expenditure required for setting up mini grids alongside the limited access to financing options for customers within the rural areas had been slowing down AGT's profitability. Moreover, the ImpactSites had an average break-even-point during year nine of its operations. The limited capital of customers in rural villages made it difficult to secure upfront payments meaning that AGT had to rely on outside financing as for instance from Development Financing Institutions (DFIs). Moreover, mini grids could only be operated economically when economies of scale were developed, meaning that a permit to electrify at least 50 villages had to be secured, making it more difficult to reach profitability in the short-term. Additionally, the Public-Private-Partnerships environment in which ImpactSite operated, had so far required long project development times and had only been generating revenue in the medium to long-term. To electrify villages, a subsidized share of 20% to 30% was required by DFIs, which often required extensive

application processes and a significant company size to be approved. Moreover, the political instability had brought along major challenges during its operations affecting various ImpactSites, leading to operations being shut down and frozen assets. Changes in government policies in sub-Saharan Africa had always been very volatile creating uncertainties and hindering the smooth implementation of projects, causing delays and increased costs. Political risks as such, impacted the company's profitability by affecting project timelines and increasing operational expenses. Regulatory barriers with complex licensing processes and bureaucratic hurdles had posed challenges in further establishing operations.

Path to Profitability – AGT's Strategy to Scale

In fall 2021, the team around Torsten and Wolfgang looked at AGT's strategic direction. The company's shift from solely focusing on ImpactSites for rural communities towards serving a broader range of clients such as C&I customers as well as Residential customers became more evident. The demand for Africa GreenTec's operations was not in doubt with a growth rate of 217,000 mini-grids in Africa by 2030, connecting 500 million people (Energy Sector Management Assistance Program 2019, 2). However, the question for the founders remained; how AGT should best utilize its resources, knowledge, and network to expand its mission in becoming commercially viable while creating sustainable impact in all areas of business. Wolfgang believed, that branching out into new business units would allow the company to operate faster and independently of local authorities.

Changes in the Market

SSA had seen an increase in population with an expected growth from 1 billion to 1.7 billion by 2040, setting an increase in working-age population of 20 million per year over the following

decades into motion (Abdychev et al. 2018, 19). With a rapid expansion in the labor force, the team saw an accelerated migration towards urban regions and cities, increasing the need and infrastructure for urban jobs (see Appendix E). Opposed to this growth, it was predicted that the population without access to clean fuels would increase to 1.1 billion in 2030 from 923 million in 2020 (United Nations 2023, 46). Simultaneously, the dependence on fossil powered energy supply and diesel prices had been rising exponentially. This had been reducing the ability for businesses to run efficiently, triggering the rising demand for solar energy solutions especially in the C&I sector, heavily dependent on reliable and sustainable power sources. Torsten saw a shift towards more decentralized and off-grid energy solutions especially in the C&I sector and residential areas as it would allow for more optimal use of renewable energy, reducing and even eliminating the need for fossil fuel. Additionally, falling costs of off-grid solar power would make it more affordable and investible.

Commercial & Industrial Projects

The rapid growth in population and GDP had not only posed significant opportunities to AGT but also other stakeholders within the SSA market had to adjust to the immense growth. The C&I sector, including hospitals, hotels, and energy intensive industries, had been expanding, demanding more and more supply of energy, accounting for 75% of the power demand in SSA (see Appendix F) (Ngono 2021). Their compounds had been connected to the main grid, which posed major issues in the past, including frequent power cuts, harming operations, and efficiency. Diesel generators had been used to serve as a backup during such outages, however, their high operational costs and excessive CO₂ emissions made them less than ideal of a solution. These potential customers heavily relied on old diesel generators and were urged to transition their facilities toward the utilization of green energy. The team saw a great opportunity as their energy infrastructure

would be configurable to the specific client needs. Wolfgang saw the opportunity to offer individually dimensioned rooftop or open-space solar systems for industrial customers which had high power requirements. A reliable and clean power supply would give companies the basis for sustainable and economic growth with lower tariffs opposed to commercial grid electricity tariffs (see Appendix G).

Residential Projects

The growth and migration towards urban areas had opened the potential for AGT to tap into a new market. Providing reliable and self-sufficient energy solutions not only to rural areas but also private households in urban areas, would allow AGT to serve a broader customer base. Wolfgang saw the potential to offer its SolarUP system, a versatile PV home solution, designed to meet the unique energy needs of private households. This would eliminate the frequent power outages and enhance the continuity of power supply to residences. The system was unique as it had the ability to function both on and off the grid, meaning that in the case of an energy surplus, residents had the opportunity feed the excess electricity back into the grid, generating additional income. Further, tailoring the system to the unique clients' needs, the SolarUP had different ranges of capacities, ranging from 5kWp to 30kWp, with different battery storage options from 5kWh to 120 kWh.

Evaluating the Options: Staying on Course or Embracing New Opportunities

The team recognized the advantages of creating the new C&I and Residential business units as it allowed the company to tap into a potentially lucrative market for C&I customers. The establishment of a residential business unit would enable AGT to provide reliable and self-sufficient energy solutions to private households in urban areas next to the rural areas, which in turn addressed the energy needs of a broader customer base. Nevertheless, the team was unsure

whether this market was big enough to enter and how accessible the market and its customers were. Additionally, the political uncertainty within these markets posed another barrier and aspect to closely consider in case of expansion. Torsten and Aida were skeptical, should they stay on course, focusing on expanding ImpactSites within the current countries of operation as well as geographically to new countries? Or was it the right time to tap into new markets and diversify their business units? How should AGT best deploy its resources to further its mission of providing electrify and economic opportunities to communities within sub-Saharan Africa? Is the establishment of two new business units the right way to go? How could AGT account for the political risk within these countries? Was it worth to face additional risk to diversify? All these questions were surrounding the team and the right answers had to be found to make the right decision

2. Evaluation Report

2.1. Introduction

Over the past years and in the face of market globalization and technological advances, a shift in companies' focus on the "underserved needs of the low-income segment in developing economies" have been observed (Goyal, Sergi, and Kapoor 2017, 97). This segment is often referred to as the Base of the Pyramid, making up a heterogeneous group of around 4 billion people with an average daily income of less than USD2.15 (Hammond et al. 2008; Galal 2023). Opposed to established economies in the west, this segment lives and transacts in an informal economy, spending most of their income on consumption-based items such as food and kerosene, while simultaneously lacking "access to life improvement and capacity building measures [such as] clean energy, preventive healthcare, financial inclusion, and education" (Goyal, Sergi, and Kapoor 2017, 97). The emergence of social enterprises within the BoP market as a response to this lacking infrastructure for sustainable development poses a huge opportunity but brings along challenges for institutions including governments, non-governmental organizations (NGOs) and corporations. Despite the vast economic opportunities, most of these institutions have been struggling to establish a scalable and sustainable business model due to the complex nature of the market, its infrastructure, economic conditions, and unique customers (Goyal, Sergi, and Kapoor 2017, 98). Moreover, the political landscape in these countries and accompanying instability increases the complexity and ambiguity of this market to not only create societal value but remain commercially viable, enabling continuous operations and impact. AGT identified a fundamental issue in the lacking access to clean energy, building products and creating an infrastructure to support the development of SSA through its diverse product range. Nevertheless, there have been major obstacles including grid infrastructure, non-cost reflective tariffs, political instability, and market

complexity at a country level leading to a lack of transparency (Lausberg, Evans, and De Jongh 2021). This ultimately challenges the strategic selection of suitable markets for expansion of the company's operations as a complex set of factors must be taken into consideration.

2.2. Situation Analysis: Geographical Expansion

In 2023, AGT decided to expand its business operations by establishing two new business units, namely a C&I and Residential business unit, with the goal to ensure the company's long-term commercial viability while simultaneously creating the greatest potential impact for its customers. An expected growth of more than 1,000% in the demand of mini grids would allow the business units to have the potential to connect 500 million people to the energy grid by 2030 (Africa GreenTec 2023). The initial focus on rural areas through mini-grids and ImpactSites with activities solely in the public-private partnership sphere revealed long project development times, generating revenue at most in the medium to long term. Additionally, the necessary financial resources needed to roll out projects have been rather difficult to secure through investors such as the World Bank, Development Financing Institutions (DFIs) and customers. Expanding operations into other business areas brings along the potential of faster implementation by operating independent of local authorities, necessary to ensure long-term commercial viability. Accordingly, the C&I and Residential business sector pose great potentials to focus on larger scale projects providing electricity to hospitals, hotels, energy intensives industries, and production facilities within the C&I market, and private customers in urban villages within the Residential market. This expansion will allow AGT to enter new partnerships, leverage higher buying power, and a faster return on investment. However, so far, AGT has only been operating in four countries, namely Mali, Niger, Senegal, and Madagascar with 24 ImpactSites under operations and subsidiary operations in Namibia and Zambia. With regards to the new C&I unit, it is only under operation

in Senegal and further expansion is necessary to secure profitability. Regarding the Residential unit, AGT has so far not entered any markets. Selecting the right markets to enter with the current and new business units while carefully considering the risks associated with entering new countries within the SSA region poses a crucial challenge.

2.3. Evaluation Purpose and Background

Throughout the case study and teaching notes, AGT's business strategy, financial standpoint, and political challenges were closely examined and analysed. Taking a step further, this report will take on a forward-looking approach to focus on the future direction AGT should undertake to ensure long-term success. To reach commercial viability, AGT must geographically expand its current and new business units. Thereby, the most suitable markets with the highest potential of successful adoption of AGT's solar energy solutions must be identified. However, assessing new markets for opportunities to entry can often result in subjective decision making (Lausberg, Evans, and De Jongh 2021). To ensure right market selection, implementation, and operations, a **two-stage model** was build based on extensive research and data collection (see Appendix H). **Stage 1**, analysis the potential of each SSA country according to three main categories and corresponding sub-categories with data points. **Stage 2** provides comprehensive recommendations and implementations for the final set of the most suitable countries found in the first stage. Thereby, specific focus on the political risk within each country is placed.

First, a literature review will be provided, taking a close look at the current renewable energy market in SSA and its market potential. Moreover, the role of independent power producers (IPPs) such as AGT, operating as for-profit social enterprises in the SSA market will be examined, including the challenges faced in these environments. Lastly, the different types of political risk

will be defined to understand how and why it is affecting organizations operating in SSA. Based on the literature, a gap has been identified as to which criteria are the most crucial for IPPs operating in the solar energy market when evaluating markets to enter. Lausberg, Evans, and De Jongh (2021) table was adapted through extensive qualitative research grounded on interviews with representatives of AGT and other stakeholders in the solar energy market. Thereby, three main categories alongside a first level criteria and sub-criteria were derived and adapted to the table. Moreover, the in-depth interviews with AGT representatives and external interviewees, were used to assign weights to each criterion, ranking countries accordingly. Thereby, comprehensive findings on the most suitable countries for expansion are provided. This is crucial for AGT during the expansion of their operations in the C&I and Residential market as it alleviates the market entry risks and increases the likeliness of operational success.

2.4. Literature Review

Renewable Energy Market in sub-Saharan Africa

Sub-Saharan Africa is an immense area with 49 countries and each one of them having its unique geographical characteristics. With around one billion people living in 25 million square kilometers, it makes up an immense region (UNDP 2023). With a vast part of the region being subject to sunlight throughout the year makes these countries a viable option to leverage the abundance of solar energy. To assist the energy needs of communities and businesses, solar energy can easily be used and applied all over the region (UNDP 2023). Renewable energy in sub-Saharan Africa has been a crucial topic for the past years as it is one of the greatest opportunities for the continent to move toward economic development due to its abundance in solar energy. Moreover, it can foster an increase in the regions GDP and employment rate. This has led to a constant rise in renewable energy funding all over the continent stemming from both governments and the

private sector. However, the amount of money invested to this day is still far from what is estimated to be needed to achieve the sustainable development goals (IEA 2022). This growth in funding is essentially due to the increase in creative financing which is an essential part of solar energy projects expansions. Adding to that, the shift towards renewable energy has been highly supported by international organizations and global climate funds, for example the African Development Bank has made it an organizational priority (African Development Bank 2023). A change in policies and frameworks in the region can be seen, adjusting, and adapting to the renewable energy initiatives to attract more investors in the sector. The implementation of new policies like tariffs, custom fees exemptions, and several tax initiatives all over the region has been increasing (World Bank 2023c). However, there are still some regulatory risks and inconsistent policies discouraging investments. That is why more regulatory stability, secure investment, and transparency is required in all countries to initiate a better flow of investments (International Renewable Energy Agency 2023a). Africa has accounted for more than 70% of off-grid sector spending. And with 75% of the population without access to electricity living in Africa, it is understandable that there is a high investment flow that grows at cumulative annual growth rate of 83% (International Energy Agency 2021). Despite these high numbers the current level of investment will not be enough to reach electricity for everyone in need any time soon (International Energy Agency 2021). The renewable energy market in sub-Saharan Africa is without any doubt a very appealing market for investment for private companies and social enterprises, as there is a huge demand and a supply which is nowhere near to equilibrium.

Market Potential for Renewable Energy

The African market represents a considerable growth potential for the future, especially in the industry of solar power. According to Eggoh et al. (2011), energy is among the most important factors for economic and socio-economic growth in a country. By 2100, dozens of African cities, growing at a fast pace, will join the ranks of the world's largest megalopolises (Ledur 2021). However, approximately half of sub-Saharan Africa's population are still lacking access to electricity. Those who do have access to electricity pay nearly twice as much as consumers elsewhere in the world. Power shortages cost the continent between 2% and 4% of GDP each year (Adesina and African Development Bank 2023). The continent's weak energy supply combined with its growing population has increased the demand for electricity to 3% a year. Nowadays, the primary energy sources in the area can be linked to coal, oil, and traditional biomass, which includes wood, charcoal, and dry dung (Holtz and Golubski 2021). While this energy mix is relatively cheap, it is insufficient to meet current needs and causes serious harm to the environment and human health (Schwerhoff and Sy 2020). Therefore, the continent's energy sources will need to change, especially if African governments aim to provide a healthy environment for citizens and meet the emission limits for greenhouse gases set out by the 2015 Paris Agreement. West Africa has been experiencing great levels of sunshine exposures, making the continent ideal for harnessing solar energy (UNDP 2023). More precisely, the continent is home to half of the world's solar radiation, and 80% of its land surface has yearly radiation levels greater than 2000 kWh/m² compared to around 40% of China's land area with comparable solar radiation levels (Pourasl, Vatankhah Barenji, and Khojastehnezhad 2023). The continent's energy future relies mainly on solar energy as it has the resources necessary to produce it. However, the promotion of solar power has been significantly delayed despite the efforts of the Economic Community of West African

States to define and adopt National Renewable Energy Action Plans through its regional policy on renewable energy (UNDP 2023). The number of mini grids will increase from 21,500 in 2022 connecting 47 million people, to 217, 000 connecting 500 million people by 2030 (World Bank 2023c). On top of the market potential, the solar energy market in Africa presents numerous benefits. Environmentally, 210,00 mini grids powered by solar energy have the capacity to avoid 1.5 billion tons of CO2 emissions globally. Moreover, solar energy provides national with a perfect, paving the way for a more financially sustainable future grid expansion in the sector. Furthermore, an increase in governments granting compensation payments for contracts held directly with them can be seen.

IPPs as For-Profit Social Enterprises in the sub-Saharan African Market

This report adopts Goyal, Sergi, and Kapoor's (2017) definition of social enterprises as an “organizational entity that focuses on the BoP segment's underserved needs, is driven by the social mission, and generates social and economic value for the stakeholders involved.” Over the past few years, the emergence of social enterprises within sub-Saharan Africa has seen a tremendous growth and importance within the context of development across the continent (Moreno and Agapitova 2017). According to the World Bank, 126 Independent Power Producers (IPPs) in 18 sub-Saharan countries can be found and have been accounting for an installed capacity of 11 GW and 25.6 billion investments (World Bank 2023c). However, these IPPs must be much larger while spreading across the region to reduce extreme poverty and boost economic prosperity in the region. Within the context of self-sustainable social enterprises, the goal of these types of businesses opposed to a conventional business, is to primarily address the social issues for the general interest of society whereas profit generation is the secondary driver, leading to a socio-economic

orientation. According to Santos (2020), social entrepreneurship “has become an important economic phenomenon at a global scale”. In many cases, social enterprises establish links between public and private domains, utilizing private resources to facilitate the public welfare (Ozili 2022). With the focus on addressing underlying needs and issues affecting the general society in these countries, some of the most striking innovations originate from developing countries, involving the deployment of new business models catering directly to the basic human needs (Seelos and Mair 2005). There seems to be particularly interesting characteristics for social enterprises within the SSA region, one reason being its young and fast-growing population. According to the World Economic Forum (2023), one in four people in the world will be African by 2050 with more young Africans entering the “workforce each year than in the rest of the world combined” (World Economic Forum 2023). SSA’s rich natural resources alongside the world’s largest free trade area combined with a 1.2-billion-person market, creates huge potentials for a new development path when channeling its resources and people (World Bank 2023c). Therefore, IPPs such as AGT play a crucial role in “exploiting renewable energy potential in SSA countries” (Lausberg, Evans, and De Jongh 2021). However, SSA is a highly diverse region, with low, lower-middle, upper-middle, and high-income countries, of which 22 are fragile or conflict-affected according to the World Bank (2023c). This leads to several challenges as IPPs cannot enter every market due to the high costs, risks, as well as low success rates, mainly associated with procurement programs, in turn forcing IPPs to be selective (Lausberg, Evans, and De Jongh 2021).

Challenges Faced by IPPs in the Renewable Energy Market

SSA can be characterized by major social and environmental issues, which, if recognized, can lead to great opportunities for business creation and the people living in these countries and

regions. Taking a closer look at the social implications social enterprises can have, past research has uncovered three main areas of impact, namely, market development, job creation, and the supply of essential goods (Barran et al. 2020). However, operating in such volatile and ambiguous environments brings along several challenges. In many cases, the lack of resources and poor governance often present great barriers for social enterprises. Past literature has identified three main challenges social enterprises face in undeveloped markets (Goyal, Sergi, and Kapoor 2017).

(1) The market setup found in these countries poses the first barrier in enabling successful operations. The presence of informal institutions, lack of effective government politics and guidelines as well as the under-performance of governmental institutions contribute to a difficult market setup. These factors make it difficult to enter and operate in such market as it leads to a lack of transparency and informal information flows and operations. (2) The underlying infrastructure leads to another challenge that social enterprises need to maneuver. The lack of reliable and sufficient infrastructure in terms of electricity, water, roads, technology, and transportation across rural as well as semi-urban areas makes it difficult to build efficient operations minimizing bottle necks. (3) Last but not least, the customers themselves are crucial when entering to closely analyze. Opposed to the well-known market in the western and developed countries, the BoP market is characterized by low-income levels with irregular cash flows, large household sites, irregular savings patterns, mobility barriers as well as low literacy levels. For social enterprises to serve the needs of these markets in a sustainable manner, close consideration must be paid to these challenges (Goyal, Sergi, and Kapoor 2017).

Political Risks in sub-Saharan Africa

A surge in conflicts and violence across SSA has been exerting a “dampening effect on economic activity, with climate shocks poised to exacerbate this fragility.” (World Bank 2023). Military coups in countries including Sudan, Niger, and Gabon have also been hampering growth not only in the Economic and Monetary Community of Central Africa but also in some Sahel nations affecting operations of IPPs.

Political risk can be defined as the risk that investors, firms, organizations, and countries will lose money or make less money than expected, due to political decisions, conditions or events occurring in the country or emerging market in which they have invested. It is the risk to business interests resulting from political instability or political change. According to the OECD, political risks are associated with government actions which deny or restrict the right of an investor or owner to use or benefit from his assets or reduce the value of firms and entities (OECD 2008). It includes war, revolutions, government seizure of property and actions to restrict the movement of profits or other revenues from within a country and is often connected with government instability, crime levels, currency inconvertibility, nationalization, terrorism, riots, coups, or civil wars. Political Risk can therefore affect all aspects of the international business from the right to export or import goods to the right to own or operate a business. The AON categorizes risk based on economic, exchange transfer, strike, riot, or civil commotion, war, terrorism, sovereign non-payment, legal and regulatory, political interference, and supply chain vulnerability.

There are different types of political risks depending on the specific characteristics of each political setting. One prominent risk category is expropriation, which is the likelihood that government actions or weaknesses in governance will profoundly shape the commercial

environment of a country. It involves a government forcefully taking possession of privately owned assets without offering just compensation in return. This poses a significant challenge as it can disrupt property rights, potentially leading to financial losses for businesses and investors due to insufficient compensation. South Africa is an example of country that moves towards stringent laws to allow expropriation of property without compensation.

Political violence is another type of political risk. It can be measured with the absence of violence score and is defined as any violent or hostile acts undertaken with the primary objectives of either changing or overthrowing the government of the country or changing its policies. It is the deliberate use of power and force to achieve political goals (WHO 2002). It is characterized by both physical and psychological acts intended to injure or intimidate communities. It includes shootings, detentions, deprivation, purposeful denial of basic requirements and human rights, as well as any impediment to free expression.

Transfer (or conversion risk) is another type of political risk and measures the likelihood of a government imposing conversion or transfer restrictions, which would significantly affect the commercial environment. The transfer risk may arise when a currency is not widely traded, and capital controls prevent an investor or business from freely moving currency in or out of a country. It can be due to sudden changes in value, new restrictions, or market conditions. Moreover, transfer risk can impact various parts of a transaction and may hinder the movement of goods in and out of a country, as businesses operating in an African nation must adhere to its government regulations.

Effects of Political Risks on Social Enterprises

Political instability can disrupt normal business operations, leading to damaged infrastructure, interrupted supply chains and compromised employee safety. It can also impact the overall investment strategy and viability of the business. Transfer restrictions for example can hinder financial transactions, affecting a business's ability to repatriate profits and manage international transactions. It can also affect funding sources since investors will be reluctant to invest in unstable countries. Indeed, the fear of economic and political instability and potential disruptions may lead to a reduction in financial support for social enterprises, impacting the ability to implement and sustain impactful initiatives. This can directly affect the capacity of enterprises to make a lasting impact and may force them to scale down operations, limit the scope of projects or even withdraw from certain regions. Political risks also introduce uncertainties in the regulatory environment, with potential changes in laws, policies, and government interference. Social enterprises may find themselves navigating legal complexities and facing operational constraints due to sudden policy shifts. The effect on economic activity resulting from conflicts and violence further affects market demand and consumer spending, making it challenging for businesses to establish and maintain a market presence, and to attract new partnerships with both local and international entities. Political instability can also increase the vulnerability of supply chains which can cause delays, increase costs and potential loss of business opportunities. The presence of political violence can also make it difficult to attract a skilled workforce who may be reluctant to work in an environment with security concerns, which can impact the overall workforce productivity and create additional hurdles.

2.5. Research Question

Although the African continent has been frequently presented “as the next frontier” for business, we have identified a gap in the current literature within the criteria IPPs should consider

when evaluating market entry in the solar energy sector (The Economist 2013). To leverage and foster these environments, effectively selecting and entering the right markets is crucial. The literature review has pointed out that the solar energy market will see a constant rise in demand and that social enterprises play a tremendous role in this change. However, there are various challenges hindering social enterprises to successfully leverage these markets. Moreover, the underlying political risk in these countries has been vastly neglected in combination with market selection which is inherent for social enterprises to create sufficient value in terms of impact and sustained business operations. As a social enterprise, AGT has responded to a pressing issue of energy poverty within the Sahel region and aims to continue and expand its operations on a larger scale. The complex market setup, infrastructure, and customers pose major difficulties in effectively selecting and entering the right markets by minimizing the political risk exposed to. This study aims at determining the most suitable countries for expansion for IPPs such as AGT within sub-Saharan Africa, namely answering the following research question:

How can social enterprises operating as Independent Power Producers in the solar energy sector strategically select new markets to enter in sub-Saharan Africa in the light of political instability?

2.6. Methodology

2.6.1. Purpose

In pursuance of answering the above stated research question, qualitative, and quantitative research was conducted to (1) determine the most crucial categories with criteria and sub-criteria inherent to IPPs for market selection and (2) assign weights to each of the categories, criteria, and sub-criteria according to their relative importance. Next, through quantitative research, data points were collected to determine an aggregated score for each category. Ranking sub-Saharan countries

from most to least favorable for renewable energy market entry with regards to the business potential and political situation, will allow AGT to have a sound knowledge of suitable markets. Moreover, country specific recommendations will be provided alongside suggestions for implementation with specific focus on the political risk in each country. This framework will be useful to all social enterprises wishing to enter, pursue, or expand their activities in SSA within the solar energy sector. Therefore, the results of the research will provide a greater understanding of the correlation between market selection and political risk, the hierarchy of political risks, and the different stakes social enterprises encounter in SSA and risk mitigation.

2.6.2. Qualitative Research

In pursuance of building the structure for the two-stage model, qualitative research was conducted to obtain the relevant categories, criteria, and sub-criteria for market assessment. Thereby, various employees from AGT, other enterprises, and industry experts in the renewable energy sector were interviewed. The decision to interview stakeholders of social enterprises specialised in the African continent and/or the renewable energy sector was crucial as it provided extensive knowledge with regards to the energy, economic, and political landscape. However, the interviewees still differed on many factors such as age, origins, experiences and point of views, which automatically added value to the ongoing debate. Indeed, this diversification of knowledge within the sample of persons interviewed provided different responses and standpoints to the issue at hand. The experience so as the demography are an important point of differentiation since answers relied on both experience and knowledge. All participants interviewed work or have worked in numerous countries in Africa.

Internal In-depth Interviews

Eight separate interviews with three different employees from various departments and management levels were conducted to get a comprehensive understanding of the business operations, business development, internal procedures, and culture of AGT. Internal interviews were key to all stages of the research process as it provided a deep understanding of the procedure and most crucial factors for AGT to successfully operate in SSA. The eight interviews took on different structures, treated various topics and followed different recurrency during the last months. (1) Enzo Cenci, former Senior Corporate Finance & Risk Manager, was the first point of contact with AGT. The purpose of these two interviews were to fully understand the missions, values, and objectives of AGT upon its creation until today from a financial and risk perspective. Moreover, his financial background provided insights regarding the risk mitigation efforts AGT had employed in the past, which challenges the company has been facing, and how it relates to business expansion. These discussions were primordial as they built a strong holistic foundation to the analysis. (2) Theo Saur, the Finance & Operations Manager, became the strongest link with AGT. The purpose of his interviews was to get more specific insights on the financial and strategic aspects of the company, understanding how operations are linked to financial success. He attended eight internal meetings, one being alongside Senior Project Manager, (3) Lucia Kamati. This interview was crucial due to Lucia's position as a Senior Project Manager. In-depth insights into AGT's objectives regarding business development and AGT's expansion strategy were obtained and used to assess the importance of the categories and criteria within the model.

External In-depth Interviews

To gain a better understanding of the overall market from an external perspective, interviews with various experts and industry analysts were conducted to further build and validate

the model. Thereby, it was crucial to collect knowledge, testimonies, and information from different stakeholders of the industry based on four interviews. Renewable energy trends, the evolving policy landscape, risks, and best practices for the social enterprise sector in Africa were uncovered. To best apprehend them, the first person interviewed was an expert in the healthcare industry in Africa, (1) Philippe Belliard. He was successively head of business development for an international medical services company, then founder and CEO of Health in Motion, which provided medical support to large industrial projects in Africa, and designed turnkey, large-scale public health projects to states and international organizations. Today, Philippe accompanies multinational companies in designing and rolling out their global employee benefits strategy, with a focus on access to medical services and wellbeing resources. The second person interviewed is (2) Aguste Minot, the head of Sales & Partner at FiltraLife Solution (FLS). FLS has developed a revolutionary machine filtering water source, apart from seawater, to provide quality drinking water. Thirdly, employees from the International Energy Agency also shared their analytical expertise on the subject. (3) Curtis Brainard, the Digital Communications Manager answered more business-oriented questions. Sylvia Beyer, Senior Energy Policy analyst, Javier Jorquera, the Energy analyst and Heyymi Bahar, Senior Analyst gave this research more depth in its analysis of the renewable energy industry. The fourth interviewee (4) Pierre Malbec and is an expert in the field of Renewable Energy and Investments in the African region. Indeed, Pierre worked for 9 years for an enterprise delivering comprehensive solutions to boost decarbonization, productivity, and energy transition in the built environment as a Global Accounts Director. Following that, he worked for several years for an Impact investment fund as a Corporate PPA lead before becoming Principal, Energy Strategy & Investment at AWS. Conducting external in-depth interview were crucial to this research as it helped narrowed down the choice of criteria used for the rest of the

analysis. Indeed, building a model solely on quantitative information would lack of objectivity as sometimes there are valuable insights that can't be find through numbers.

2.6.3. Quantitative Research

Data Points

To assess the potential for renewable energy projects in sub-Saharan African countries, we opted for a quantitative approach gathering secondary data from various data banks for the first stage of the model. Based on the categories, criteria, and sub-criteria defined through the qualitative research, publicly available data sources and databases were used to collect quantitative data points on the three key areas: the energy potential, the socio-economic appeal, and most importantly the political risk indices. This will create an understanding of the potential of each market in SSA to derive a sound selection of the best markets to enter. We considered different data points, in form of metrics or indexes, the research and data collection consisted of using publicly available, especially governmental data from the world bank database as a primary source of information, but also other database and reports were used alternating between the Global Solar Atlas, the International Energy Agency (IEA), and International Renewable Energy Agency (IRENA) for the Energy and Solar potential. Data from the Heritage Foundation, the United Nations, the U.S Energy Information Administration, the Freedom House Indexes, the World Economic Forum for the Economic and Political Criteria were used. This comprehensive data collection from the previously mentioned sources led to an analytical process creating an aggregated scoring and ranking of each country across the three categories, which steered the research to a cross-category integration where we combined insights from the energy potential, socio-economic, and political assessments to form a holistic view of each sub-Saharan country's

prospects for renewable energy projects for social enterprises. The use of Microsoft Excel as a primary tool to facilitate data management, calculation, and visualization was deployed.

2.7. Findings

Based on the qualitative and quantitative research, a two-stage model was established to determine the most suitable countries for expansion. During the first Stage, four main categories have been identified based on the interviews conducted and are summarized in the table below. Within each of these categories, first level criteria have been determined based on which a second level of sub-criteria were identified. These sub-criteria describe the data points collected from various databanks (see Appendix I).

Category: Energy

According to the interviewees, specifically with representatives of AGT, the **Energy Category** was perceived as the most important when selecting new countries to enter and is divided into two main criteria (Saur, Internal Interview no.1, July 25 2023). As AGT's products are highly dependent on solar energy, entering a country with these products implies the need for a great (1) *Solar Potential*, comprising the first criterion. Therefore, the *Average Theoretical Potential GHI* (kWh/ m²), *PVout* (kWh/kWp) and *PVout SI* were used as sub-criteria to determine the overall solar potential of each SSA country through selected data points (see Appendix I). The second criterion found from the interviews was the underlying (2) *Electrification* within a country to understand the potential for a new electricity system. A country with a high electrification rate is rather unappealing to AGT as it implies the country to have a sufficient supply of energy and a strong network of electricity, making it difficult to create demand for their products (Kamati, Internal Interview no.6, November 15, 2023). The *National Electrification Rate* was thus used as

a sub-criterion to determine the least electrified countries, implying a potential high demand for solar products. Lastly, the current *Solar Energy Generation (Billion KW)* was selected to compare the countries current use of solar power, which if low, suggests a higher possible demand for AGT's products. Based on the outcomes of the interviews, a weight of 75% for (1) *Solar Potential* due to the dependence of those project on criteria like Solar Irradiance and Seasonality Index and a weight 25% was attributed for (2) *Electrification* as it represents a more immediate, infrastructural aspect of energy that can be overcome in the future. Those weights were built to determine the aggregated score for each SSA country.

Category: Economic

The **Economic Category** was identified as another important factor for market selection according to the interviewees, with four criteria. The first criterion constitutes the (1) *Economic Performance* of each country, defined by the sub-criteria of *GDP per capita*, *Economic Growth*, and *FDI Inflow* as the percentage of GDP. This is important to consider as it identifies the country's growth prospects and potential demand for such products (European Commission n.d.; Malbec, External Interview no.4, December 12 2023). Moreover, the *FDI Inflow* sheds light on openness and effectiveness of the economic system and the underlying economic development which would be favourable to IPPs entering the market (OECD 2002). The second criterion looks at the underlying (2) *Business Environment*, with the *Corporate Tax Rate*, *Business Freedom*, and *Terms of Trade Indicator* as the sub-criteria for the data points. This is crucial as it considers the global competitiveness of individual economies (Valášková, Gajdosikova, and Kramarić 2022; Belliard, External Interview no.1, November 15 2023). Third, the (3) *Energy Infrastructure* makes up another criterion within this category as it is crucial for AGT leverage stable logistics processes

(Kamati, Internal Interview no.6, November 15 2023). The *Logistics Performance Index*, *Electricity Consumption (Billion KW)*, and the *LCOE (Average Lifetime Levelized Cost of Electricity Generation)* are used as sub-criteria. Lastly, (4) *Human Capital* is the last criterion with the *Literacy Rate* as the sub-criteria for the data points. This was selected as AGT leverages local human resources for its business operations, creating the demand for a certain level of competence. Weights were assigned accordingly with 30% for (1) *Economic Performance*, as it includes factors like GDP, growth rates, and similar metrics while important, they are not the sole determinants of economic health. A weight of 25% for (2) *Business Environment*, including corporate tax and ease of doing business as it emphasises the business climate, acknowledging its importance in fostering economic growth. 35% for (3) *Energy Infrastructure*, a higher weight as it includes the energy price which is determined to be a very important indicator and finally 10% for (4) *Human Capital* with literacy rate as a sole indicator, a crucial factor that contribute to economic success.

Category: Political

The core problematic of this research revolves around the political environment's impact on market expansion for social enterprises in sub-Saharan Africa. Therefore, the **Political Category** plays a crucial role in the model. Indeed, the political situation of a country can easily be a deal-breaker in a company's decision to enter a market. In fact, all interviewees, be they from AGT, entrepreneurs or long-time experts of the social enterprise industry in Africa, agreed that the diplomatic environment can tip the scales. Drawing a red line on countries with high political instability, which referred to context of war, coups, terrorism, and heavy corruption is crucial when determining the country to enter (Minot, External Interview no.2, November 17 2023). According to (Belliard, External Interview no.1, November 15 2023), his experience with his clinics being

pillaged in Chad during an attended coup showed him the importance of taking into consideration the political instability of the country in the contractual terms. Therefore, building solid and impactful criteria for political context was primordial for the relevance of the framework. The first criterion is the (1) *Governance and Institutional Effectiveness* weighted at 48 % as it regroups many important criteria subtypes such as the *Rule of law*, *Government effectiveness*, *Voice and accountability*, *Regulatory quality*, *Control of corruption*, *Corruption perceptions – Transparency Internationally*. These sub-type criteria are valued trough points from -2,5 being “weak” to 2,5 being “strong”. The second criterion (2) *Civil and Political Rights* with a weight of 24 % and it takes a closer look at the and entails two subtypes: *Political rights* and *Civil liberties*; ranked from 7 “weak” to 1 “strong”. Lastly, (3) *Security and Stability* with a weight of 28% is the third criterion, it is composed of *Fragile state index*, which was ranked from 0 to 120, *Political stability* that follows the same system point system as the subtypes of the first criterion & *Absence of Violence/Terrorism: percentile rank*.

2.8. Pre-Selection

Prior to the Stage 1 analysis in which countries are ranked according to the highest aggregated score based on the criteria defined, a pre-selection was conducted. This is an important step as it narrows down the number of countries based on the minimum condition. To score a country it must have to be considered a potential fit for market entry during the pre-selection.

First, AGT is currently operating in five countries, namely, Mali, Niger, Senegal, South Africa and Madagascar, which will be excluded from our Stage 1 analysis. This leaves 44 potential countries within the SSA region to be analysed through the model. Moreover, a maximum score for the political instability and minimum score for national electrification rate are determined to

further pre-select the most desirable countries. The sub-criteria of political instability and national electrification rate were hereby chosen as they create the baseline condition for a country's suitability. If the country is experiencing high political instability, it does not qualify as suitable for IPPs as it is unsafe for the company and its employees to operate in. In the case of high national electrification, we have further limited the pool of potential countries as it is not economical for AGT to enter a country with an already high electrification rate, thereby making AGT's products obsolete. Concluding, the final set of countries which will be analysed by the model are a total of 33 sub-Saharan Africa countries.

2.9. Stage 1: High Potential Country Selection Analysis Results

The following section will shed light on the results obtained from the Stage 1 model analysis within each of the three categories and discusses the total aggregated scoring to select the countries with the highest overall potential. First, looking at the *Energy Category* and *Economic Category*, the overall *Business (Category)* potential will be determined. Next, the model will rank the countries based on the *Political Category* data points to pay special attention to the underlying political risk in the market.

Category: Energy

Within the energy category, Mauritania, Burkina Faso, Botswana, and Namibia have ranked amongst the highest. This implies that the *Solar Potential* in these countries is significantly high for effective operations of solar energy products. Moreover, the *Electrification* is supposedly low, meaning that there is a high chance for demand and the adoption of solar energy products. The map below showcases the countries with the highest aggregated scores. Countries AGT already operates in are highlighted, meaning they are not further considered for the analysis with

regards to AGT's expansion strategy. However, they can be considered for general selection of IPPs in the solar energy market (see Appendix J).

Category: Economic

The Economic score has been determined using several criteria as stated above, depicting the continent's big economic struggle with distinctive differences between SSA's countries. Most countries did score quite low as shown in the map below, however we can see some countries leading with high economic growth prospects such as Mauritania, Ghana, Gabon, as well as Namibia, and Botswana. The economic growth of some countries can lead to a future change as Africa is constantly growing and the pace is different from a country to another (see Appendix K).

Category: Overall Business Potential

An overall Business potential score has been determined by merging the Energy and Economical scores. This showcases the country's most suitable on a business level, reflecting the potential energy demand and the economic prosperity of the countries at hand. Thereby, the results have uncovered that Mauritania, Burkina Faso, Namibia, and Botswana have ranked the highest amongst the countries AGT has not yet entered (see Figure 2).

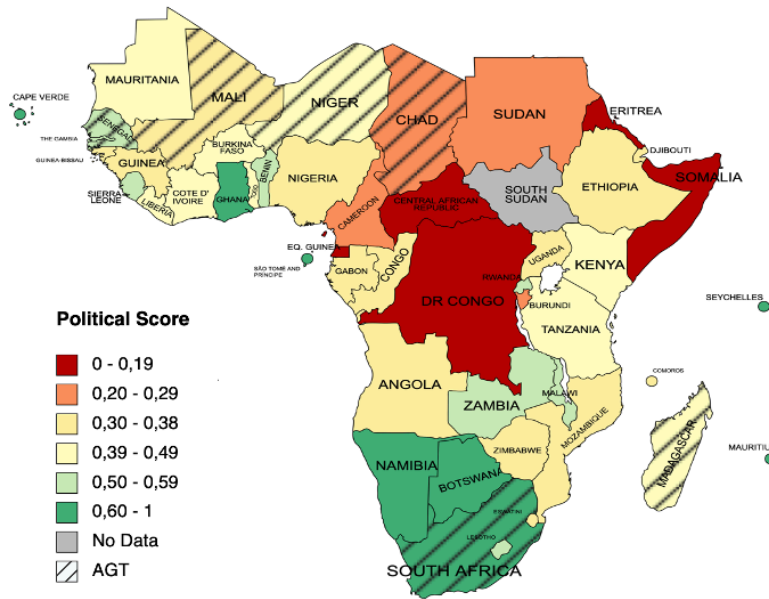


Figure 2. Final Aggregated Political Score. *Source:* by authors.

2.10. Stage 2: Recommendations and Implementations in Light of Political Risk

Mauritania, Burkina Faso, Botswana, and Namibia have been identified to be the most suitable countries considering the business potential and political landscape. This section will explore recommendations and implementations based on the internal and external interviews conducted. Recommendations drawn will specifically focus on minimising the political risk inherent in these countries and how AGT can navigate through these environments. Moreover, it will be linked to the country's energy state, economic conditions, and potential market to provide recommendations accordingly.

Country 1: Mauritania

Mauritania is recommended to be selected for further expansion as it is ranked amongst the highest for each category relevant to IPPs, implying a high potential and suitable environment for successful adoption of AGT's solutions. Mauritania is located in the northwest of Africa with a

territory spanning 1.030.000 square kilometres and a total population of 5 million (International Energy Agency 2023b). Half of the population lives in urban areas in the south-west of the country and can be characterized by its young and fast-growing population. The economic growth has been increasing at a constant rate, with a GDP twice as high in 2022 compared to 2008, implying a growing business environment, making it attractive for IPPs (International Energy Agency 2023b). According to the International Energy Agency (2023b), most of the country's population, particularly in rural areas, lives in poor conditions without access to modern energy supplies. Mauritania's government has established the objective to electrify 40% of the rural population from the currently electrified 3% by 2030 (Bordat and Curnier 2019). The power sector is dominated by the state-owned utility Société Mauritanienne d'Electricité (SOMELEC), three large mining companies, currently using their own generator to power their operations, and a rural electrification independent agency (see Appendix L). The new 2022 Electricity Law, has further opened the electricity sector to IPPs by splitting the state-owned electricity into four entities, making it extremely attractive for AGT to enter.

Engage in Strategic Partnerships with the Big Three Mining Company's

The mining industry in Mauritania accounted for one-quarter of the total GDP in 2021 with three main operators (see Appendix L). The current energy use of the industry is heavily reliant on fossil fuels to operate mining equipment and to electrify sites. Within remote locations, power is mainly provided by diesel generators. According to representatives of the IEA, the deployment of renewables would benefit the mining industry by improving mining operations through lower costs, reduced emissions, and increased efficiency while improving energy security (IEA, External Interview no.3, November 28 2023). AGT should pursue partnerships with these large operators

to supply their sites with its renewable energy products, supporting the project development within the new C&I business unit. A trend towards the adoption of renewable energy within the mining industry can be seen and AGT's experiences, know-how, and products are a great fit to enter such partnership. AGT can leverage the company's presence in the market in terms of knowledge and buying power while sheltering itself from the political risk inherent in the country (Belliard, External Interview no.1, November 15 2023). Moreover, mining operators benefit from the partnership as they can outsource the renewable electrification of their sites to AGT, being an expert in the field. Once operations of these mining companies have stopped, the surrounding communities can continue benefiting from the established mini grid or systems can be relocated (Belliard, External Interview no.1, November 15 2023). The mining companies, First Quantum, Kintross Gold, and Aya Gold and Silver are located in the west, close to the sea and should be approached by AGT (see Appendix M). This makes it easy for AGT to ship products to those sites. Moreover, a planned network of transmission lines provides the needed infrastructure for AGT's products (Bordat and Curnier 2019). The population density is higher in the west of Mauritania, allowing AGT's products to be beneficial to communities living in the surrounding areas, further providing electricity and revenue for AGT. The main Iron ore mine operator, SNIM, is another potential and valuable customer with operations in the north of Mauritania (see Appendix L).

Focus on Regions Close to Nouakchott and the Sea (C&I and Residential BU)

Focusing on regions close to the capital city Nouakchott and the sea is recommended for C&I and Residential business unit expansion (Belliard, External Interview no.1, November 15 2023). Within this area, urban areas have been growing, creating the perfect target market for the Residential unit. Moreover, its geographical proximity to the sea makes the logistical process to

reach urban areas efficient by having products shipped to their destination minimizing the transportation across the country. Additionally, its proximity to Senegal, creates an advantage as AGT's headquarter is soon to be located in Dakar. Moreover, having a geographical distance to politically instable areas such as the eastern and southern borders to Mali, alleviates the risk of operations having to shut down, ensuring long-term operations and return.

Engage in the Green Mini-Grids Market Development Programme

The African Development Bank (AfDB) has developed a Green Mini-Grids Market Development Programme, aiming to foster the access to electricity by assisting stakeholders to overcome challenges in the implementation of mini-grids. It is highly recommended for AGT to take part in this programme and tenders to enter the Mauritanian market. Moreover, it will establish an understanding of the mini-grid market and provides AGT with a link to communities, public institutions, and financiers necessary for the development of ImpactSites, C&I or Residential projects. AGT's stance in other markets and successful implementation of various ImpactSites will create a competitive advantage and distinction to be considered for this programme.

Rural Area Development

Rural area development is crucial in the context of Mauritania. According to the International Energy Agency (2023b), 50% of the population living in rural areas are still lacking access to clean energy and it has remained the government's top priority to provide these communities with electricity. This poses a great opportunity for AGT, and it is recommended to introduce mini-grids and ImpactSites to these areas. According to Bordat and Curnier (2019), 2.2 million people in rural areas "will be best served by mini-grid solutions in Mauritania". Moreover, estimates of the

potential mini-grid market have located it on the southern border with Senegal due to the underlying “low electrification rates, limited grid coverage, and population densities high enough to support min-grids”. The geographical proximity to AGT’s Senegalese headquarters can be again leveraged and creates a closeness to the market. AGT should thereby engage in tenders offered by the SOMELEC to apply for the planned grid network expansion in these areas.

Country 2: Burkina Faso

Burkina Faso’s (BF) energy, economic and political risk’s scores of the model indicate that the country is an attractive business target for expansion for social enterprises in the solar energy sector in SSA. Indeed, the analysis through the stages and numerous discussions with experts of the industry and the region allowed us to raise recommendations for the market entry of AGT in Burkina Faso. The energy score for Burkina Faso ended up being its highest of all three criteria. Indeed, landlocked in the heart of the Sahel, BF has a strong solar potential but unfortunately is still low on electrification. Indeed, Burkina Faso is among the least electrified countries in the world. Moreover, the country is facing a rapid growth in domestic energy demand other sectors such as the industry, transport, and urban domestic demand. Normally, these gaps are filled with traditional biomass and butane gas. Lastly, BF is a member of the Economic Community of West African States (ECOWAS) and its last government had the ambition to electrify at 95% of the country, 50% being rural areas by 2030. More importantly, the past government also had the ambition to set a target of 50% in renewable energy (SEforALL Africa Hub 2017). However, the government with this ambition is not the one in place nowadays. Indeed, the Burkinabès experienced two coups in the year of 2022 led by the military that plunged the country into political crisis. Insecurity and violence from militia groups, terrorists and government forces obligated

millions to be displaced. This affected greatly the economy of the country as its growth slowed to 2,5% that year which impacted more poor households relying mainly on agriculture. Nevertheless, the country's future is optimistic as its growth is projected to rebound to 4,3% by 2023 (World Bank 2023a). Indeed, both private and public consumption are projected to be at the origin of this forecast due to sustained elevated levels of public spending. In the medium term, there is an anticipation of a recovery and acceleration in private investment, while the primary and tertiary sectors are poised to continue as the primary engines of growth.

Establish a Dialogue with The Burkinabès Government Through the Help of a Third Party

First and foremost, if AGT would enter the solar energy market in BF it would be primordial for them to have a direct and good relationship with the government. The latter being new and unstable since 2022, a relationship based on trust and mutual respect should be built beforehand. To do so, creating contact through a respected and already implemented in the country, company, institutions, or NGO related to the renewable energy sector could be key. Indeed, reaching out through via a third party prevents AGT of potential tensions, builds confidence, ensure more diplomacy from both sides and objectivity. Moreover, the intermediary will grant expertise and experience of operating in Burkina Faso under this given government. The African Development Bank (ADB) created the Africa Energy Market Place (AEMP), a collaborative investment platform that aims at lighting up and powering Africa by 2025. The intention is to remove barriers to private sector investments as the AEMP focuses on one country to prioritize. Moreover, the initiative is also to offer opportunities to government officials to engage with peers in different countries and learn from their best practices relevant to the energy sector. Lastly, AEMP promotes interaction between the finance and private sectors which helps the identification

of investment opportunities and avenues of potential financial support. In other words, the AEMP sparks conversations aimed at advancing strategic projects within African countries. AGT and Burkina Faso could really benefit from the AEMP's expertise and diplomacy in the establishment of a relationship and implementation projects.

Demonstrate That Responding to the Strong Demand Could Have Political Gains

Indeed, the Burkinabè government needs to understand the added value electrifying the country would have on their presidency and population. Captain Ibrahim Traoré, the man holding the power, recently cancelled the elections due to an issue in security in some regions of the country. Demonstrating that access to electricity is correlated both to security and national elections could be key in the discussion. AGT's team should argue the benefits of electrification in terms of economic, information, health & well-being and social security and stability. In fact, it should be stressed out that electricity ensures that power industries, businesses and infrastructures are effectively powered, and that the contrary could hinder economic growth. Moreover, without electricity many communication systems such as the ones for emergency services and security cannot function which is dangerous in times of threats and emergencies such as attacks, conflicts. Indeed, having a sustainable access to electricity is a matter of national security and defence, but also cybersecurity. This argument is important as Captain Traoré's mantra is to improve national security in the country. A growing economy in a secure country contributes to an increase in overall quality of life which enhances all social aspects. For instance, medical facilities, equipment & services' efficiency also depend largely on the smoothness of electricity. Lastly, one of the most important reasons electrifications in all regions of a country is

access to education. To empower the next generation, enabling the use of technology in education and fostering innovation is primordial.

Prove That AGT Is The Only Fit for This Mission in This Given Country

Africa GreenTec, if accompanied by a mediator such as the African Bank of Development initiative, the African Energy Marketplace, could be the ideal choice for Burkina Faso's electrification. It is important for AGT to remind the government that the Burkinabè's population has a strong specific demand that corresponds exactly to AGT's offer. Indeed, Burkina Faso ranks among the least electrified countries in the world, currently standing at an overall electrification rate of 19% with 60% of the urban population and only 3% of the rural one. All three business units of AGT answers this specific issue, and this is the most crucial argument the company has. Indeed, AGT provided at first solar energy solutions such as the Solartainer, and the Impact Sites in rural areas but recently the C&I and residential areas business units have also been developed. The expertise and experience gained from the electrification of rural areas and the recent deployment of activities in residential and C&I areas emphasize AGT's relevance to take on this project. Moreover, Burkina Faso's strategically location for the company should be pointed out in order to reassure the government for two reasons: transport & culture. Indeed, AGT's products are being imported from Germany to the African continent. However, Burkina Faso being landlocked in the heart of Sahel, shares borders with countries where AGT operates which will ease the transportation of the containers. Additionally, it is important to mention that the company is not only German headquartered as it also has offices in Dakar, Senegal. This information is valuable as it shows that AGT does not only employ locals from afar but is actually part of the continent

and understands its complexity. This argument will really differentiate AGT from other foreign social enterprises wanting to expand to sub-Saharan Africa.

Draft a Contract Based on Safety

Lastly, the safety for AGT's team is the most primordial factor in deciding whether or not to enter a certain market. Burkina Faso has shown to be rather unstable since 2022 politically and therefore requires a special approach. A recommendation regarding safety and protection against any political instability would be to draft in the contract a special clause demanding military protection & insurance for all AGT's employees and subcontractors. Indeed, requiring a special treatment should be a right and duty backed up by a contract between the government and AGT and supervised by a mediator. The insurance is also required in case of any sort of attack against AGT's employees and property. This last requirement should be the redline on the decision to go or not to Burkina Faso as assuring the safety of all AGT's staff is the most important one.

Country 3: Botswana

The approval of the Integrated Resource plan in 2020 and the Rooftop Solar initiative underscore Botswana's dedication to achieving a reliable, secure, and affordable supply, with a clear shift towards renewable energy. Despite presently relying heavily on coal, Botswana is targeting 30% renewable energy by 2030 and 50% by 2036 (International Renewable Energy Agency 2023b), actively revising policies to attract solar investments. The establishment of the Botswana Energy Regulatory Authority in 2017 further signals the commitment to a diversified and sustainable energy landscape, positioning the country as an ideal destination for enterprises in the solar energy sector like AGT. Botswana's economy is traditionally reliant on diamonds for

90% of its exports, which lead the country to face economic challenges, also exacerbated by climate conditions. In response, the government started implementing strategies to diversify the economy. The country first started prioritizing investments in human capital and fostering private sector growth. Recognized as one of the most attractive investment locations in sub-Saharan Africa, Botswana boasts a business-friendly environment with no foreign exchange controls, low tax rates and a remarkable score of 65 in business freedom. Botswana also demonstrates commitment to growth through ongoing infrastructure investments and innovative initiatives like the Botswana Innovation Hub, positioning itself as an accessible and supportive market for business implementation. Moreover, Botswana stands out as an ideal environment for social enterprises to expand due to its political stability, exemplified by its stability index of 0.98, the highest in sub-Saharan Africa. With an absence of violence score of 87, the country has maintained a legacy of peace since its independence in 1966. Its commitment to eradicating corruption is a cornerstone of Botswana's governance, reflected in its recognition as the least corrupt country in Africa by Transparency International. Botswana is a multi-party democratic country, and the Botswana Democratic Party's longstanding rule and the regularity of general elections every five years allow transparency and participatory democratic process.

Engage with the Botswana Government

Regarding the political, economic, and energetic context, AGT should first build closer ties with the Botswana government since it is capitalizing on its commitment to advancing solar energy and reducing reliance on coal. This engagement should encompass collaborative efforts to support investment and foster private sector development. Additionally, considering the upcoming elections in 2024, establishing connections with the next political party in power could prove

advantageous for alignment with evolving governmental priorities. To do so, AGT should present partnerships proposals aligned with the country's renewable energy goals and reducing dependence on coal.

Analyze the Botswana's Country Private Sector Diagnostic (CPSD) and Learn from Successful Companies Expanding in Botswana

AGT should analyze the Botswana's CPSD, focusing on opportunities and constraints within the energy sector. It should utilize the insights gained from the CPSD to inform AGT's approach, ensuring alignment with identified growth areas within the private sector. Additionally, AGT should also examine and draw inspiration from the successful implementation strategies of enterprises in Botswana and through a collaboration with the World Bank, a key player actively involved in societal and private sector initiatives. Indeed, the World Bank engage with civil society organizations and think tanks, such as the Botswana Institute for Development Policy Analysis, to gain valuable insights into effective strategies and potential areas for synergy, which can be reliable information for AGT. AGT should analyze the implementation strategy of Orange, a French telecommunication company who established strong presence in Botswana through a partnership with Vanu, which helps telecom companies implementing in areas not covered by mobile networks.

Align with Botswana's Vision 2036 and World Bank's CPF

AGT should analyze Botswana's Vision 2036 goals and collaborate with the World Bank's Country Partnership Framework (CPF), contributing to Botswana's development goals. By focusing on promoting private sector-led, jobs-intensive growth, strengthening human and

physical assets, and supporting effective resource management, AGT will contribute meaningfully to the upcoming CPF, aligned with the Transitional National Development Plan and NDP12, starting from April 2025.

Engage with the International Finance Corporation (IFC) and Partner with the MIGA

AGT should establish collaborative ties with the International Finance Corporation which supports private sector-led growth and economic diversification in Botswana. Indeed, it leverages ongoing engagements in the renewable energy sector and aligns with IFC's expertise and objectives. Such a partnership enhances credibility and can help attract investors by signaling a commitment to responsible and risk-mitigated business practices and then strengthened project viability. Furthermore, the enterprise should also initiate partnerships with the MIGA which supports Botswana's development through political risk insurance to promote foreign investment.

Country 4: Namibia

Namibia is the country with the highest energy score making it a great potential country to consider for expansion. The country is located in the southwest of the continent with a total territory area of 825,615 km² and a total population of 2,54 Million (International Energy Agency 2023). With a large area, the country has a variety of landscapes from the Namib Desert along the coast to the Kalahari Desert in the east, and the forest from the north to the center of the country, with most of the population located on the Atlantic coast. With a very high solar potential leading the continent score in several Indicators (see Appendix K), the country has been showing a great economic growth. The country has been known to heavily rely on the mining sectors, including diamonds, uranium, and gold which are a big portion of the country's GDP (World Bank 2023b).

The Namibian government has been focusing on diversifying their economy, aiming on new markets like such as tourism, agriculture, and fishing to reduce the dependency on mining and its vulnerability to global commodity price fluctuations (Namibia Statistics Agency 2023). For years the country has been moving towards the renewable energy market, because the country has been importing more than 59% of its energy from the Southern African Power Pool (SAPP), making it tricky for the country as it will need to invest on its own energy generation, so that the big fluctuations of the energy sector won't be a problem. The country's key initiatives include engaging with 19 Independent Power Producers (IPPs) to supply 175.5 MW of renewable energy by 2020 and the development of a National Integrated Resource Plan (NIRP) to guide the country's electricity supply industry from 2016 to 2035. These measures reflect Namibia's strategic commitment to ensuring a reliable and efficient power supply, crucial for the nation's economic growth and development in line with its Vision 2030 and beyond as outlined by the Ministry of Mines and Energy (2019).

Absorb the Namibian's Government Assistance for IPPs

The government of Namibia has been helping immensely renewable energy players establish themselves in the market, with the country high energy export it was important to seek new openings and AGT fits perfectly in the countries plan. With the electricity control board supervision and their consolidation of more than 70 electricity distributors within the country, and more importantly their establishment of transparent tariff-setting procedures and giving the full access on information regarding the energy sector, making the entry and operations in the country as smooth as possibly can (USAID 2023). The Renewable Energy Feed-in Tariffs program has

been critical for regulating the market and encouraging investments in renewable energy by IPPs, stabilizing the market and promoting the use of renewables in Namibia (Namibia Economist 2023).

Create a Strategic Partnership with Namibia's Largest Mining Companies

Namibia's mining sector is a key part of the country's economy as it represents a big portion of the GDP, not only that it is also a major employer and big energy user. Leaders in the Namibian mining sector like Namdeb Diamond Corporation, Swakop Uranium, B2Gold, and Rossing Uranium Mine have all been pioneers in corporate social responsibility (CSR) in Namibia, they have given a lot of focus and commitment to sustainable practices, community engagement, and aligning their operations with the United Nations Sustainable Development Goals (SDGs). This focus offers a great platform for AGT to introduce its products and the renewable energy solution. A collaboration between the two would be highly beneficial for the two companies as it will help the mining company reduce its carbon footprint and get an increase in popularity within the local communities, as for AGT it will gain a portion of the renewable energy market in Namibia, opening new doors for the company within the region. This partnership would unfold as AGT would provide clean energy options to power mining operations, contributing to community electrification efforts, and more importantly leveraging the mining companies' CSR initiatives and therefore promote sustainable energy use within local communities (Shilongo 2023). These partnerships are key because they combine Africa GreenTec's renewable energy expertise with the mining sector's resources and commitment to social responsibility and more importantly it would solve a big issue that renewable energy market in sub-Saharan Africa faces which is the financing (Amesho and Edoun 2019).

2.11. Sensitivity Analysis

To understand the robustness of our model, we conducted a sensitivity analysis that shows how a change in a criterion would affect the different scores calculated in the model. For that we needed to assess every score separately starting with energy score, we decided to apply a change in two criteria which were the *Average Practical Potential Seasonality Index* and the *National Electrification Rate*, by altering the data of both criteria for countries like Botswana, Mauritania, or Namibia, with an increase of 10% and a decrease of 15% we saw a slight impact in energy score of those countries with a change ranging between 0,0001 and 0,06. The change did not impact the rank of the countries in any way and therefore despite the sensitivity of the model it is not enough to affect the results. We did the same analysis for the economic and political scores with the use of criteria like *Economic Growth* and *Leveraged Cost of Capital* for the first score and *Rule of law* and *Absence of Violence and Terrorism Index* for the latter the scores were both sensitive but in a small way that also did not affect the results of our research, the full results are shown in the table (see Appendix L).

2.12. Limitations

While the study offers valuable insights on the energy potential, economic strength, and political stability of SSA countries, it is important to recognize the limitations it brings along. The procurement of the data points for all countries in SSA poses the first limitation. For several countries, the lack of availability of all the relevant data points has led to a few missing information in the model. Most of the sources used for criteria did not have a set of data from previous years, while the results for the majority wouldn't differ much between the years, there was no possibility to get an average score of previous years. While the model offers different criteria for each of the categories studied, the model did not and could not cover all the relevant factors that influence a

country's energy potential, economic status, and political stability. Additionally, there is a potential bias in selecting criteria and weighing them, although it has been assessed through quantitative research. The sensitivity analysis can help understand the change within the same criteria and its effect on the overall score, however it cannot assess the change if the criteria were altered.

2.13. Conclusion

In conclusion, throughout this report new standards for country-market based entry for IPPs in SSA such as Africa GreenTec, have been established. Looking at past literature, connecting the renewable energy operations in SSA to the political estate of the region, proved to be lacking an important element: the anticipation and mitigation of the potential risks during market selection. The holistic approach of this research made of internal and external interviews with experts of the market lead to the mapping of a country-selection model. The latter develops precisely, through the accuracy of 26 sub-criteria, the perfect country-match for business expansion while taking into consideration political instability. The model shows that forecasting and preventing political and social complications in operations for a social enterprise in risky areas is strategic. However, both interviews and the model demonstrate that risk does not have to be an obstacle, in some cases, if there are ways to mitigate it. Indeed, the recommendations show that market expansion to a political unstable country such as Burkina Faso is possible if risk is assessed before, during and after hand. Sub-Saharan Africa represents a bargain for IPPs in the solar energy market and needs to be invested in from external and internal actors. Indeed, occidental companies have the technology expertise that can contribute to saving SSA from its energy crisis, but it is only part of the solution. For the renewable systems to be sustainable and viable, risks need to be assessed and mitigated together with local forces. Risks are inherently part of the business world and therefore

should not be a brake for market expansion but an opportunity for the companies to have a deeper understanding of the country they wish to operate in. To conclude, IPPs in the solar energy sector in sub-Saharan Africa should select new countries taking into consideration different criteria. Determining if the country has a high business potential, by looking at criteria such as the electrification rate can help in understanding the underlying market. Once the most suitable countries have been selected, it is crucial to determine a strategy as to the business can work within the political landscape. Indeed, this paper has shown that social enterprises such as IPPs operating in regions as fragile as SSA is, have the obligation to know how to assess risks and mitigate them.

3. Teaching Note: Business Strategy at the BoP Market

Synopsis

In 2022, the founders and Chief Operating Officer of Africa Green Tec, a social enterprise operating in the sub-Saharan region, were facing a difficult decision. Africa GreenTec was founded in 2016 and has been operating successfully in many sub-Saharan African countries. However, the company was analyzing its financial statements in response to a board and investor meeting. Its current business model was not generating sufficient cash flow for the company to turn profitable, slowing down investments and the scalability of AGT's business operations.

The following teaching note will put students in the founders' shoes to resolve the difficult strategic decisions the company is facing: How can Africa GreenTec become profitable? Should AGT focus on its current business model? How has AGT so far been able to create value at the BoP market? Should it geographically expand its current operations? Should AGT go ahead with establishing two new business units? Are the Commercial & Industrial and Residential sectors the right markets to expand into?

Learning Objectives

This case aims to provide students with an understanding of social enterprises operating in underdeveloped economies such as sub-Saharan Africa and how to effectively serve the Bottom of the Pyramid (BoP) market.

- Assess the challenges of building and sustaining a profitable business model as a social enterprise operating at the BoP market.
- Identify how businesses can effectively serve this market, creating social impact and financial return.
- Analyze the importance of innovation in sustainable development.

- Understand why social enterprises need to be profitable to keep generating impact.
- Evaluate the factors necessary for diversification.

Position In the Course

The following case can be used in undergraduate, graduate, and executive education programs and is particularly relevant for modules focused on social enterprises in the context of entrepreneurship at the BoP market. As the case revolves around a social enterprise operating in undeveloped markets, social entrepreneurship and its underlying mechanisms in these markets are crucial and will be taught throughout the case.

Analysis

1. Link the BoP market to Maslow's Hierarchy of Needs in the case of AGT?

The very first question will develop the basis for the case study as it will take a close look at the nature of the BoP market and the role of social enterprises in serving the needs in these markets. As stated in the case, the BoP market represents around 53.2% of low- and middle-income markets, accounting for only 1.1% of the total wealth in the world and representing the largest and poorest socio-economic group. SSA is a large and untapped market, making it extremely diverse and poor in data, while many regions are difficult to reach with little to no formal education. Based on these factors, the market can be defined by consumers demanding maximum utility while being highly price-sensitive in an informal economy. People living in these markets necessitate very different goods and services compared to people in developed countries. This is an important factor and can be linked to Maslow's Hierarchy of Needs¹. Basic needs, such as Safety and Psychological needs, including food, water, warmth, and rest, are not the norm. AGT identified a lack of infrastructure

¹ Appendix N

necessary to provide access to these basic needs. This has implications as to how AGT as a social enterprise, tailored its product offerings, which can be seen in the case and appendices. Through sustainable and renewable energy, AGT supplies communities with electricity, providing access to clean drinking water, heating, internet, and more, providing the infrastructure to meet these basic needs. Moreover, AGT's product offerings, allows individuals and communities have the potential to move up the Hierarchy of Needs, gaining access to food and clean drinking water. Moreover, moving up the latter, AGTs products provide prospect of long-term employment, improved health, and access to education. For example, internet connection allows individuals and communities to access education and become connected, which in turn increases autonomy and the possibility of better healthcare, financial inclusion, and leveraging the internet for agricultural and economic advances.

How is AGT leveraging its social enterprise status, considering the basic conditions of a business?

Moreover, it is important to consider AGT's nature business. Throughout the case, it is evident that AGT operates as a for-profit social enterprise, mandating a dual approach to profit generation as well as social value creation. Referring to the three basic conditions of a business², (1) revenues must be greater than costs creating profit, (2) profits must be maintained for a sustained period, and (3) profits are equal to or greater than other similar activities of equivalent risk. To generate revenue in these markets, AGT structures its business according to three different business models, allowing the company to generate a return while operating in a market with insufficient and irregular cash flow. This allows the firm to meet its customers financial capacities, creating returns and providing value to investors. However, it is important to note that ImpactSites alone only

² Appendix O

create return in the medium to long term with a break-even point after nine years, making it difficult to operate sustainably as a for-profit social enterprise without leveraging economies of scope. This moreover questions the third conditions as the risk inherent in these markets has been hampering the company's profitability.

2. Did Africa GreenTec deploy a Pull or Push Approach to introduce ImpactSites to the market?

The next question will consider strategies social enterprises use to enter markets at the BoP. Particularly, it examines how AGT's product came to be and what the underlying reasoning was. To answer this question, the framework of a Pull/Push Approach to Inclusive Market Systems Development³ should be used. This can lead to a great discussion, as one might argue in favor of one or the other. Compared to a push strategy, which takes top-down approach with a major focus on business, a pull strategy provides the basis of the market by focusing on both business and economic growth and the long-term development of the country. From the case, it can be clearly identified that AGT deployed the pull strategy by adapting the products and services to the market demands, learning from customers, and accepting low purchasing levels. This can be seen in various aspects of the case. (1) First, Torsten and Aida identified the underlying problems with the energy infrastructure being physically on site. The request to provide electricity to rural communities lacking energy access combined with low purchasing power showcases the demand-oriented approach AGT took to build based on the market's demands. Being on site allowed the team to further analyze the underlying issues, such as the old diesel generators and lack of energy infrastructure, and how it affected various aspects of people's lives. As mentioned in the case, the team had no prior experience with the conditions in the market but rather used these experiences

³ Appendix P

to gain knowledge about the specific problems. This knowledge contributed to the first product, the Solartainer as a mini-grid solution and further enabled AGT to continuously adapt and add new products, leading to the ImpactSites. The products were thus tailored to the exact needs of the customers, the geographical environment they would operate in, as well as the underlying climate. Creating these mini-grid solutions can connect customers previously isolated from the energy grid supply. AGT thereby took on an investigative approach to the problem, trying to provide solutions that respond to the needs of the market. (2) Second, by accepting the existing supply chains, AGT enhanced the current infrastructure by providing households, farmers, and small businesses with no prior access to electricity with a dependent energy source, creating exponential productivity gains in further areas. Taking these aspects into consideration, students should identify that customer, as, for example, farmers are able to store their produce in the Cooltainer, reducing food loss and providing a chance to grow their revenues in the long term. Moreover, it is important to note that access to the internet not only provides connectivity but also allows communities to build and become part of an economy. It directly affects productivity, increases employment, economic growth, and access to education and health services. This creates new streams of income and has the potential to create jobs and improve working conditions. (3) Third, another critical aspect is AGT's utilization of the continent's number one natural resource, sunlight, building on an existing and abundant resource. (4) Lastly, AGT's business model allowed for lower barriers to market entry through its system provider, system and financing, and utility provider model, by accepting low purchasing levels. Overall, it can be concluded that AGT's unique strategic approach, focusing on market demands, allowed the firm to expand the diversity and quality of accessible economic opportunities for individuals and communities, fostering long-term economic growth in various areas.

3. Is the concept of the Three Basic Principles of Affordability, Access, and Availability applicable to AGT?

Considering the nature of the market AGT operates in, the Three Basic Principles of Affordability, Access, and Availability (The 3 A's)⁴ provide interesting insights. It will further explain and shed light on AGT's unique strategy in the market to create the capacity to consume for these customers. **Affordability** is a key aspect when providing products and services at the BoP market, as the purchasing power of these consumers is extremely low. However, it is important to point out that affordability does not imply a decrease in the quality or efficacy of the products. AGT therefore places a lot of value and importance in designing and building their technologies and products to the highest possible standard leveraging German engineering. Next, AGT ensured affordability by covering the initial capital expenditure through crowdfunding campaigns and the capital of various investors, International Financing Institutions, and local governments. This allowed AGT to build the products and have them shipped and installed in the villages. Moreover, providing their products and services through three distinct business models (System Provider, Leasing Model, and Utility Provider), enabled consumers to gain access to these services. These models allow customers a flexible and affordable solution, paying for the amount of energy used per month (e.g. Utility Provider), not needing to provide an upfront capital investment for the products themselves. Moreover, it did not create a barrier to purchase, as, for example, the maintenance and operation of these Solartainers and/or ImpactSites were taken care of by AGT employees. This made it possible for people to afford these services. Next, given the circumstances in which AGT operates in, the aspect of **Access** in these markets is important to consider. Looking at the geographical conditions of the countries AGT operates in, it becomes

⁴ Appendix Q

evident that rural villages are rather difficult to access. Countries such as Chad, Niger, and Mali are landlocked countries, making it difficult to transport large products such as the Solartainer to rural areas. AGT designed its products accordingly through its unique product design. The Solartainer takes on the form of a shipping container, making it easy for maritime distribution. On land, these containers can be moved onto big vehicles, are very mobile, and can be easily assembled and disassembled. Lastly, **Availability** is a crucial aspect when serving these consumers, the variability and uncertainty in the cash flow of BoP are accounted for by AGT's service offerings. Customers do not need to make any upfront payments and can access services on a monthly basis, paying only for the amount of electricity used. This allows customers to have the availability of electricity on a regular basis, eliminating their dependence on regular cash flows. Importantly, it can be said that the socio-economic gains AGT's provides through its products generate new income streams from economic activities such as business creation and allows customers and communities to pay for AGT's services in the long term, creating a continual cycle of financial growth.

4. Explain how AGT leveraged the 12 Principles of Innovation⁵ to serve the BoP market?

Operating within the SSA market demands companies to adapt to the underlying infrastructure to be successful. Three major factors of AGT's strategy can be recognized that allowed the company to successfully serve the market and can be linked to the Principles of Innovation. AGT realized that innovation was one of the most essential factors for a sustainable competitive advantage and adapted its operations accordingly. (1) First, through the company's ImpactSites, the need for a holistic approach to successful infrastructure development is acknowledged, building a scalable solution. A wide range of utility services are provided, answering several needs

⁵ Appendix R

at once and, moreover, improving the economic prospects for the success of the sites in villages (*3rd Principle of Innovation*). Additionally, it can be pointed out that it allowed AGT to distinguish themselves from other small mini-grid developers and operators, gaining a competitive edge. (2) Second, local value creation is another important aspect. AGT has set up its value chain with local subsidiaries and partners in the operating countries, as well as on-site trained employees, ensuring operations are aligned with the infrastructure and market dynamics at hand. It is important to note that it allows AGT to adapt to the specific needs and conditions through local knowledge and resources, building on the existing resources. Moreover, AGT leveraged its close ties with local authorities and stakeholders, initiating market integration and cooperation with governments. Working together with local authorities allowed AGT to enter the market more efficiently alongside MOUs tailored to provide the company with infrastructure requirements such as the provision of low-voltage grids, custom duty and import tax exemptions, and quicker approval of the tariff model provided by the local subsidiary (*6th Principle of Innovation*). (3) Lastly, the mobile and versatile design of AGT's technologies makes the implementation of ImpactSites quick and efficient. Considering the geographical conditions and lack of infrastructure in villages, the products are designed so that they can be installed on any surface, in any environment, and on different types of roofs (*5th Principle of Innovation*). This further alleviates the risk associated with grid expansion since sites can be easily disassembled in case of political unrest or other issues including climate catastrophes.

5. Why are ImpactSites in rural areas in the SSA market not as scalable as expected?

Although AGT has created a product portfolio that meets the demands of the market, there are several obstacles hindering the scalability of ImpactSites. It is important to point out and analyze the key factors hindering ImpactSites from being economically viable and how this can be linked

to scalability. First, the geographic settlement within SSA countries is an important factor when considering the scalability of ImpactSites. Looking at the countries under operation in Appendices A and HH, it is evident that within most countries, more than 50% of the population lives in rural areas with low population density, meaning that village sizes are rather small and widespread. Although AGT's goal is to provide electricity to rural areas, there must be more than 25 houses per km of network to leverage the full capacity of the site, making it economically feasible for AGT to enter. This leads to the second factor, the high capital expenditure for the Solartainers and ImpactSites. As the cost of an ImpactSite is relatively high considering the nature of the product, a substantial amount of pre-financing is required, mostly provided by various investors. Considering the nature of the products, with their big batteries and solar panels alongside production, shipment, and distribution, it is extremely capital intensive. Combining the small village sizes with capital-intensive technologies, challenges to efficiently scaling operations in rural areas arise as the incoming cash flow is minimal compared to the initial costs. In the case that village sizes meet the minimum requirement, difficulties in accessing grants and funding for the initial investments pose another hurdle. Due to the uncertain and risky environment, AGT has trouble securing initial funding for these projects as end-customers are not able to make such upfront payments. Finally, the existing electricity grid network poses another factor leading to difficulties for AGT to scale the ImpactSites (see Appendix S). Countries such as Niger, Chad, and Mali do not have an existing electricity grid network. Considering this, when looking at AGT's conditions to sign an MOU with local authorities or governments, should draw attention to the requirement of the provision of a low-voltage grid. It might therefore become difficult to ensure these pre-conditions on a large scale, such as 50 villages, being another minimum requirement for AGT to enter a market.

6. Should Africa GreenTec diversify its business units to ensure long-term profitability?

This question is aimed at understanding whether the business model of AGT can be replicated to serve other types of customers besides rural communities and how their product offerings can be tailored to different segments. First, there is a growing demand in the C&I sector as well as a trend towards urbanization in SSA. The C&I share in power demand is substantially large, at 75%, making it lucrative for AGT. Moreover, three factors can be derived influencing the rising demand: (1) high electricity costs; (2) frequent power outages; and (3) a trend towards renewable energy solutions. Considering the Residential sector, a shift in migration towards more urban areas can be seen in Appendix E of the case, leading to a long-term rise in demand. Next, students should draw attention to the difference in the implementation time frame for rural area electrification compared to urban area and C&I electrification. On the one hand, AGT can directly cooperate with C&I customers, independent of local authorities. On the other hand, implantation in urban areas is faster as the low-voltage infrastructure might already be in place and houses are within closer proximity, making it possible to create a single, larger energy grid. A third factor is the accelerated return on investment. C&I customers have the financial capabilities to make up-front payments, whereas AGT does not have to rely on additional funding for the initial capital expenditure, moreover, leading to a higher margin for AGT. Thus, AGT should diversify into the C&I and residential markets as it can leverage the adaptability of its different products and build upon the stronger financial capabilities of these customers.

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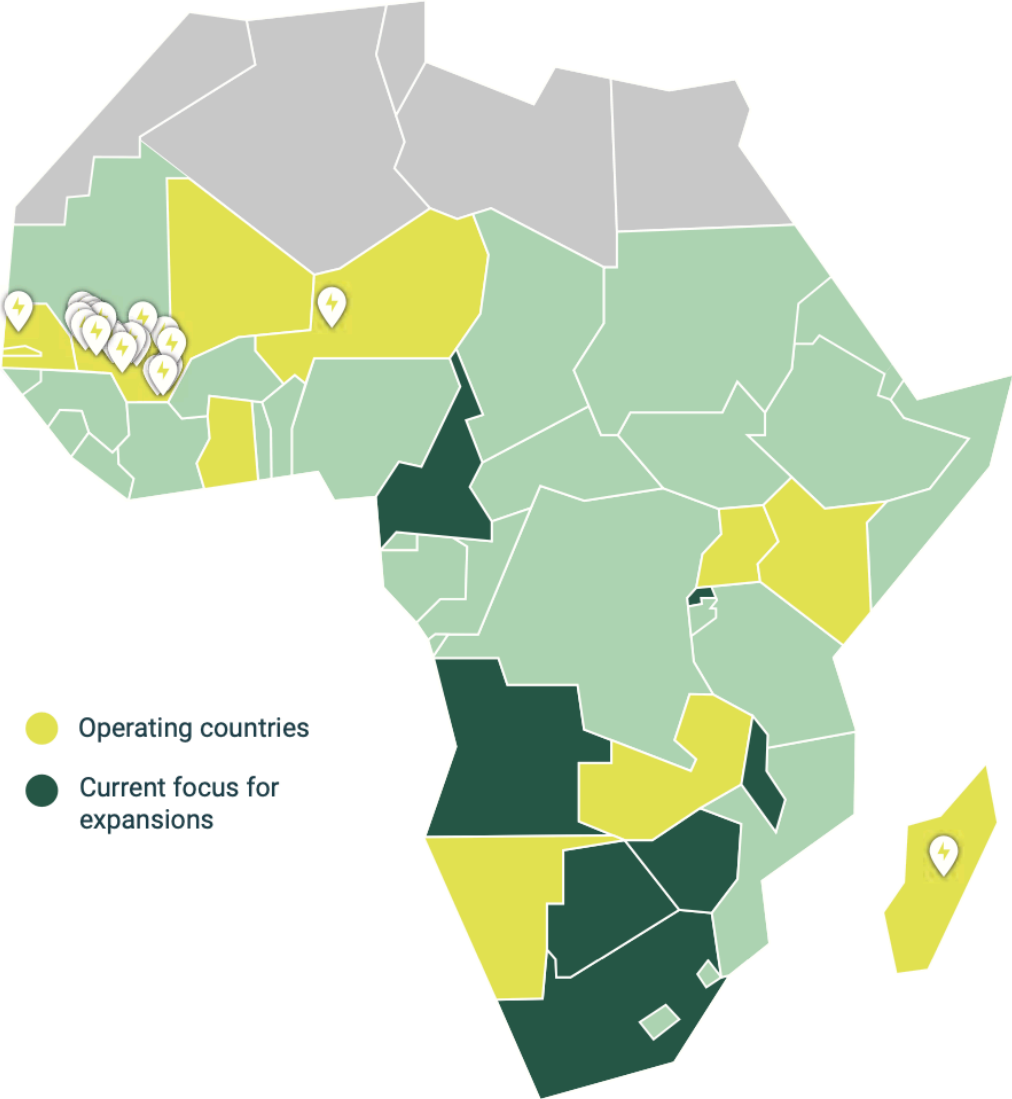
List of Figures

Figure 1: Final Aggregated Business Score.....46

Figure 2: Final Aggregated Political Score.....47

Appendices

Appendix A: AGT Operating Countries 2022



Source: Africa GreenTec. 2023. “Africa GreenTec Business Plan 2023.” Unpublished.

Appendix B: Africa GreenTec Business Models

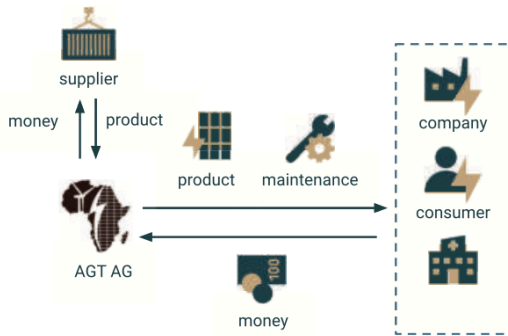


Figure 1. System Provider Model. *Source:* Africa GreenTec. 2023. “Africa GreenTec Business Plan 2023.” Unpublished.

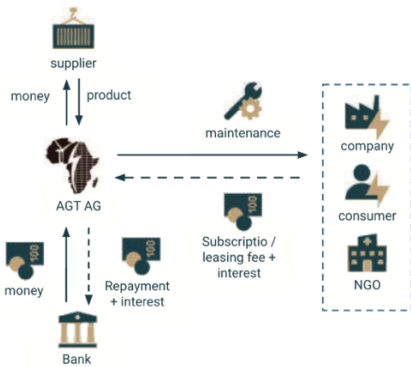


Figure 2. Leasing Model. *Source:* Africa GreenTec. 2023. “Africa GreenTec Business Plan 2023.” Unpublished.

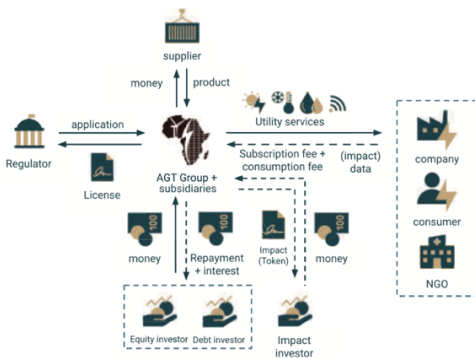
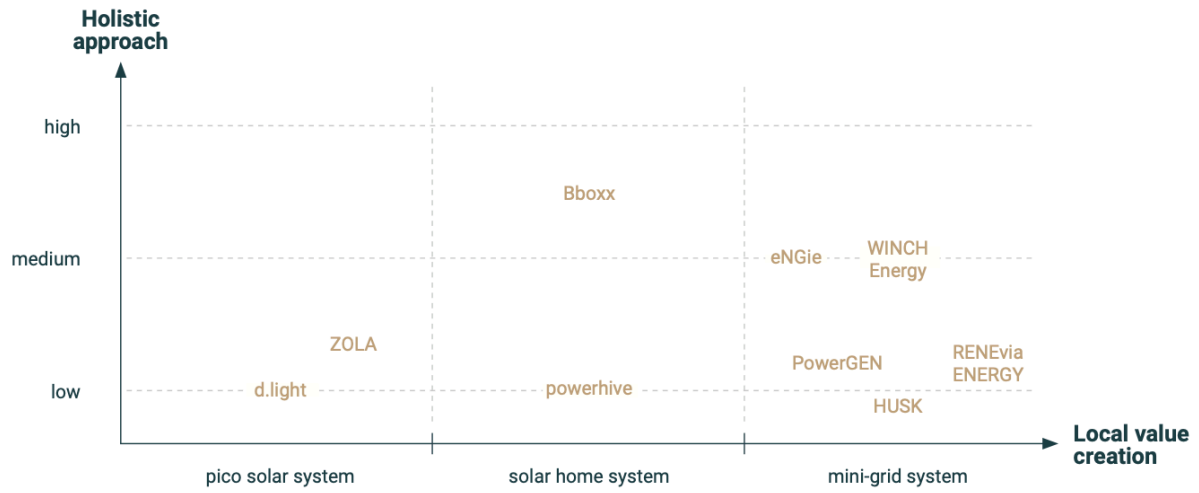


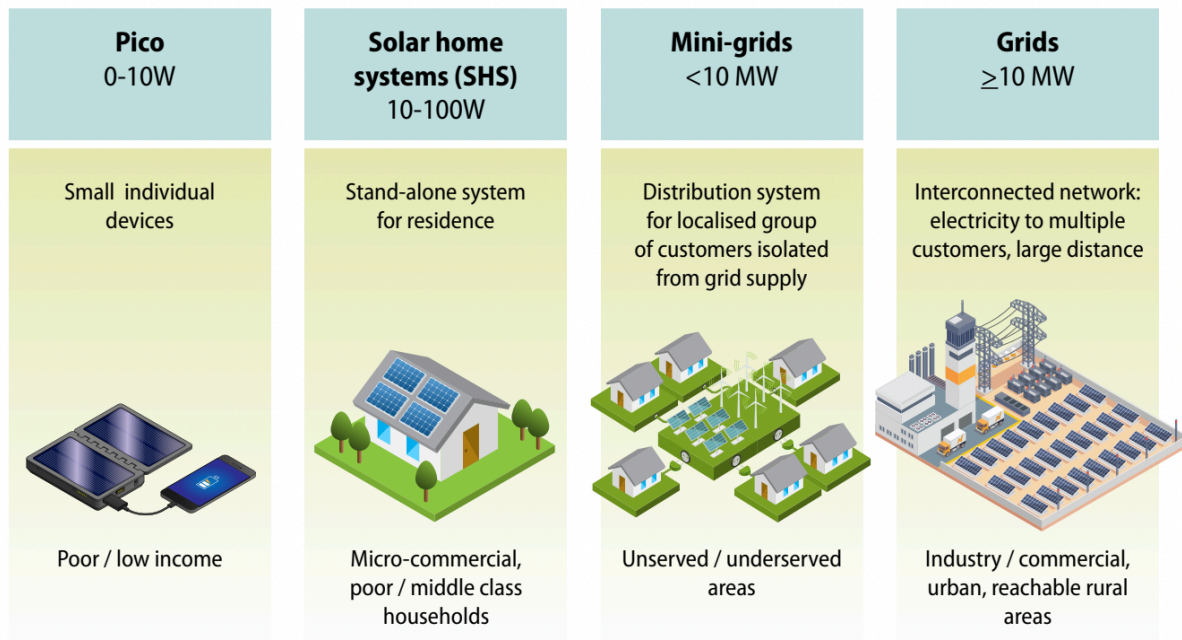
Figure 3. Utility Provider Model. *Source:* Africa GreenTec. 2023. “Africa GreenTec Business Plan 2023.” Unpublished.

Appendix C: Competitor Map



Source: Africa GreenTec. 2023. “Africa GreenTec Business Plan 2023.” Unpublished.

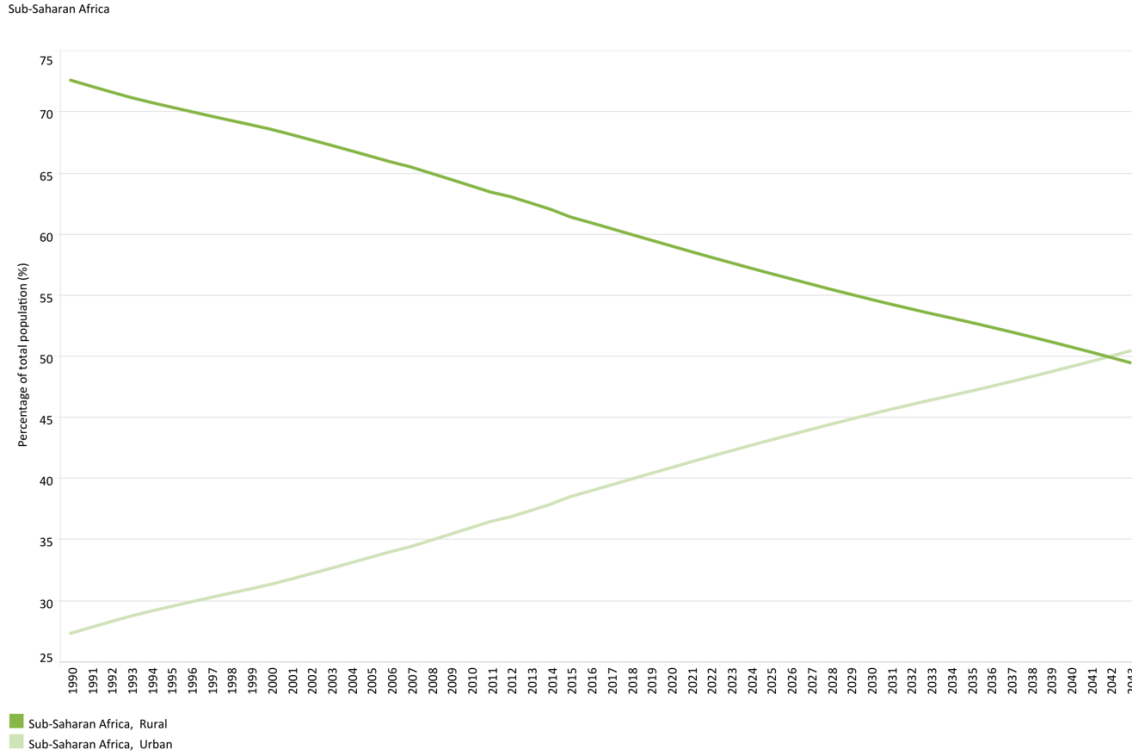
Appendix D: Renewable Technologies



Source: Corfee-Morlot, Jan, Paul Parks, James Ogunleye, and Famous Ayeni. 2019. “Achieving Clean Energy Access in Sub-Saharan Africa.” Organisation for Economic Co-Operation and Development. Organisation for Economic Co-Operation and Development.

Appendix E: Urban and Rural Population Migration

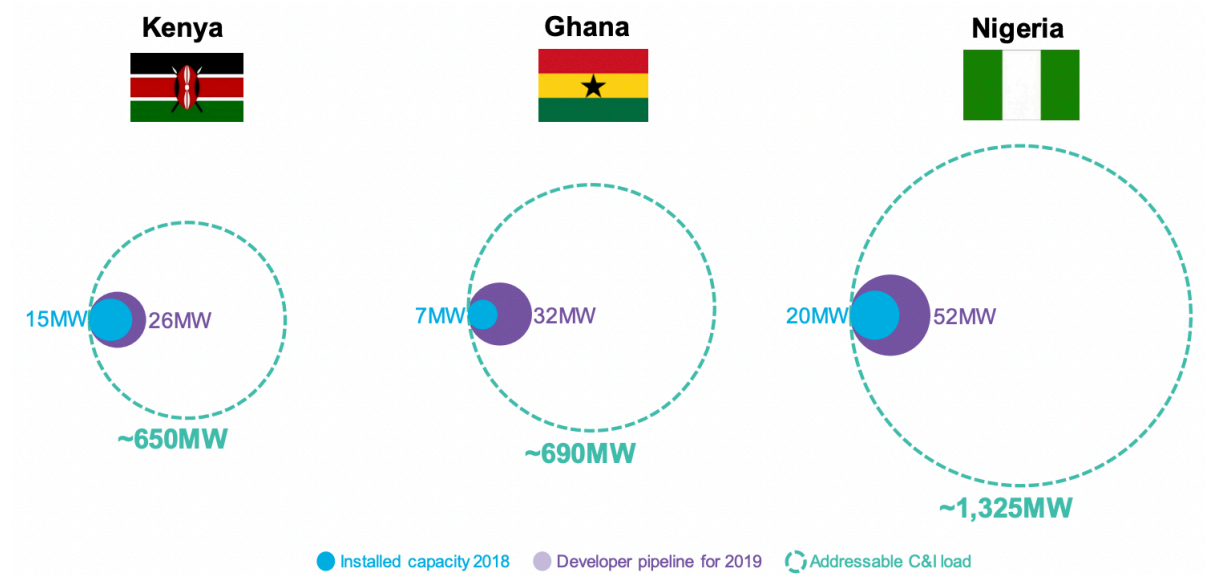
Chart 3: Urban and rural population in CP, 1990–2043
% of population



Source: IFs 7.63 initialising from UN World Urbanization Prospects estimate

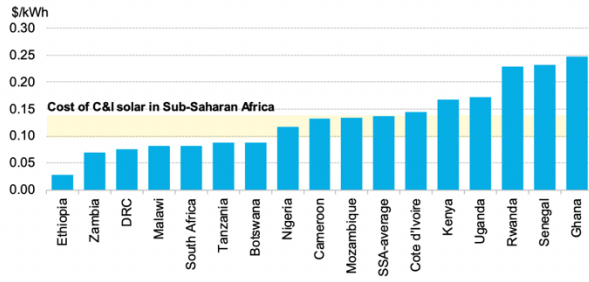
Source: Jobarteh, Mustapha. 2023. “Sub-Saharan Africa.” ISS African Futures. November 15, 2023. Accessed December 7, 2023. <https://futures.issafrica.org/geographic/regions/sub-saharan-africa/>.

Appendix F: C&I Solar Markets relative to C&I Power Demand



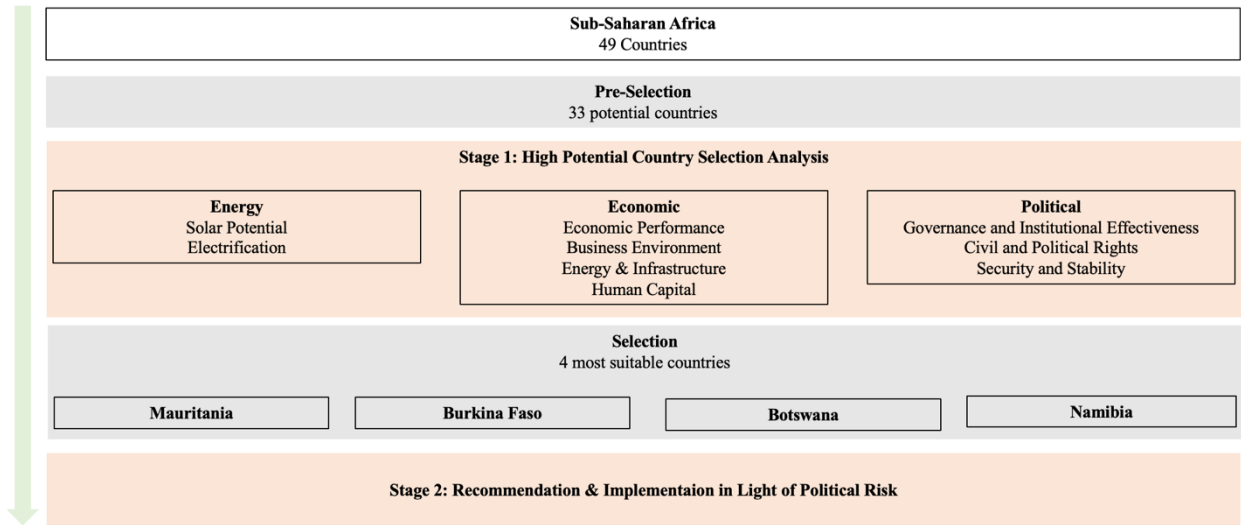
Source: “Renewable Energy: Solar for Business in Sub-Saharan Africa.” n.d. responsAbility. <https://www.responsability.com/en/magazine/solar-for-business-in-sub-saharan-africa>.

Appendix G: Economics of Solar vs. Commercial Grid Electricity Tariffs



Source: “Renewable Energy: Solar for Business in Sub-Saharan Africa.” n.d. responsAbility. <https://www.responsability.com/en/magazine/solar-for-business-in-sub-saharan-africa>.

Appendix H: Two-Stage Country Selection Model



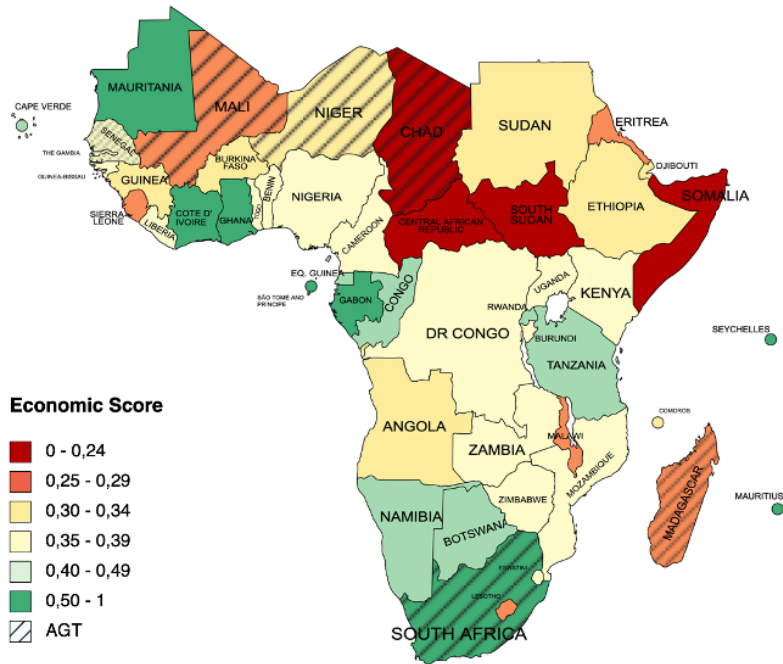
Source: By authors.

Appendix I: Selection Criteria used in Stage 1

Category	Weight	Criteria	Sub-criteria
Energy Criteria		Solar Potential	<i>Average Theoretical Potential GHI (kWh/m²)</i> <i>Average Practical Potential Level 1 (kWh/kWp)</i> <i>PVOU Seasonality Index</i>
		Electrification	<i>National electrification rate</i> <i>Solar Energy Generation (Billion KW)</i>
Economic Criteria		Economic Performance	<i>GDP per capita</i> <i>Economic Growth</i> <i>FDI (% of GDP)</i>
		Business Environment	<i>Corporate Tax</i> <i>Business Freedom</i> <i>Terms of Trade Indicator</i>
		Energy & Infrastructure	<i>Logistics Performance Index</i> <i>Electricity Consumption (Billion KW)</i> <i>LCOE = Average lifetime levelized cost of electricity generation</i>
		Human Capital	<i>Literacy Rate</i>
Political Criteria		Governance and Institutional Effectiveness	<i>Rule of law (-2.5 weak; 2.5 strong) (2021)</i> <i>Governement effectiveness (-2.5 weak; 2.5 strong) (2021)</i> <i>Voice and accountability (-2.5 weak; 2.5 strong) (2021)</i> <i>Regulatory quality (-2.5 weak; 2.5 strong) (2021)</i> <i>Control of corruption (-2.5 weak; 2.5 strong) (2021)</i> <i>Corruption perceptions - Transparency Internation</i>
		Civil and Political Rights	<i>Political rights (7 weak; 1 strong)</i> <i>Civil liberties (7 weak; 1 strong)</i>
		Security and Stability	<i>Fragile state index (0 low; 120 high)</i> <i>Political stability (-2.5 weak; 2.5 strong)</i> <i>Absence of Violence/Terrorism: Percentile Rank</i>

Source: Adapted from Lausberg, Carsten, Kathleen Evans, and Enelge De Jongh. 2021. “Effective Selection of Countries in Sub-Saharan Africa for New Market Entry by Independent Wind Power Producers.” *Journal of Energy in Southern Africa* 32 (4): 28–44.

Appendix K: Final Aggregated Economical Score



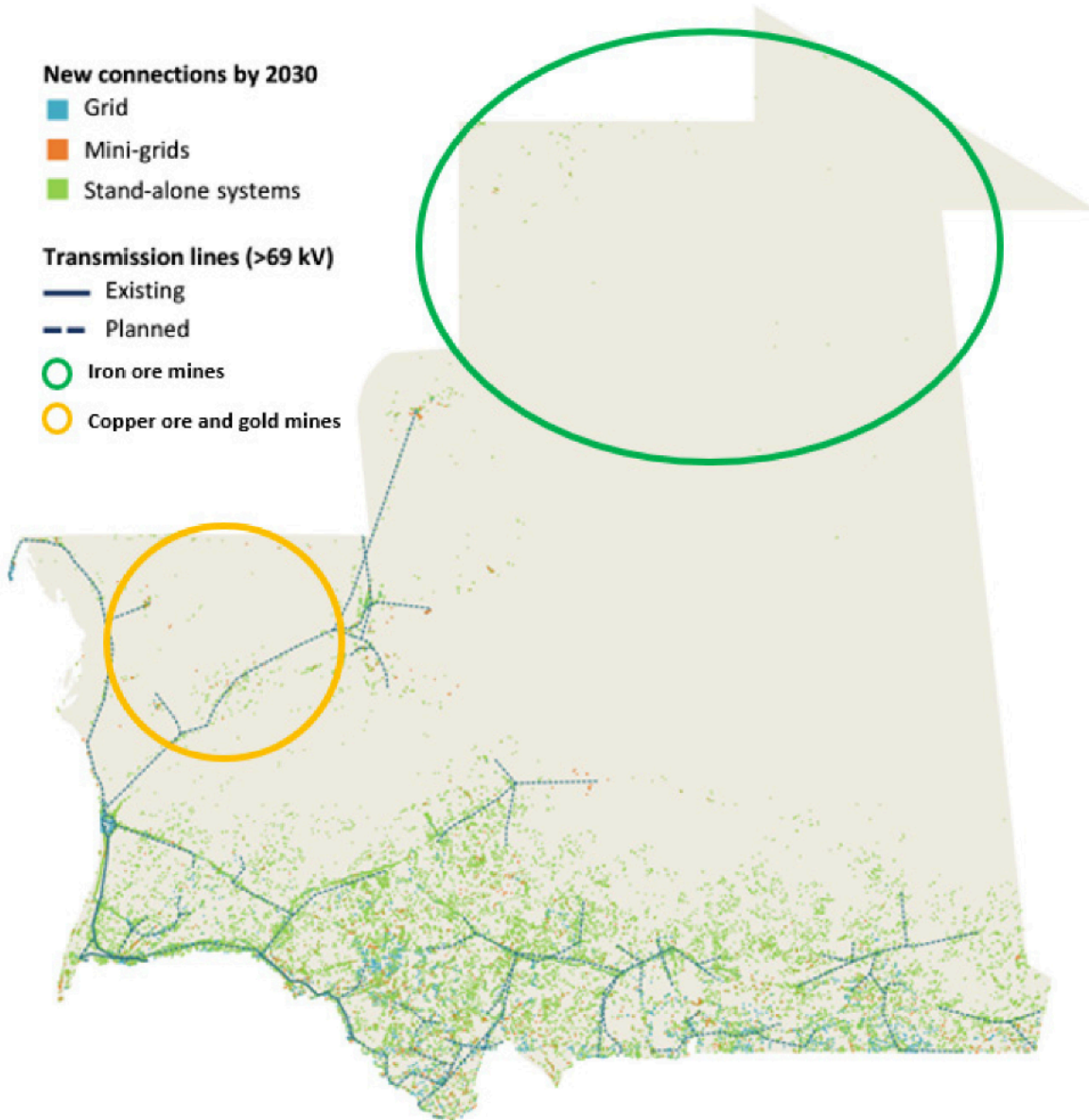
Source: By authors.

Appendix L: Three Main Players Within the Extractive Industry in Mauritania

Site	Mine	Company	Type	Production/yr
Tiris-Zemmour District	Guelb El Rhein	SNIM	Iron ore (magnetite)	5 Mt
Zouerate System iron mine	M'Haoudat	SNIM	Iron ore (hematite)	8 Mt
Kedia d'Idjil mountain (part of the Zouerate System iron mine)	Tazadit	SNIM		
	Rouessa	SNIM		
Inchiri region	Guelb Moghreïn	First Quantum (Canada)	Copper ore	13 313 t in 2022
		First Quantum (Canada)	Gold	1 tonne in 2022
Northwest of Mauritania	Tasiast	Kinross Gold (Canada)	Gold	15 tonnes (2022, following expansion)
Northwest of Mauritania	Tijirit	Aya Gold and Silver	Gold	Feasibility study ongoing

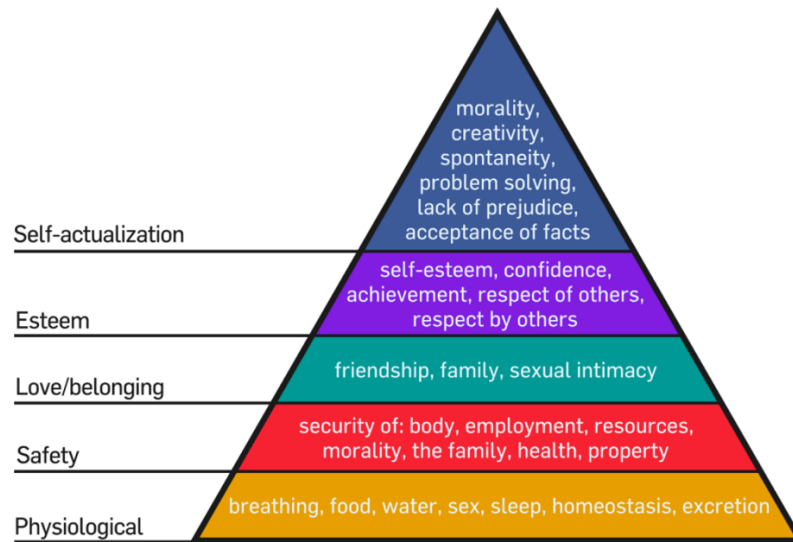
Source: International Energy Agency. 2023. “Renewable Energy Opportunities for Mauritania.” IEA.

Appendix M: Location of Mauritania's Iron and Copper Ore Mines Relative to Its Electricity Transmission Network



Source: International Energy Agency. 2023. “Renewable Energy Opportunities for Mauritania.” IEA.

Appendix N: Maslow's Hierarchy of Needs



Source: Morshed, Mehrab Bin, Koustuv Saha, Munmun De Choudhury, Gregory D. Abowd, and Thomas Plötz. 2020. "Measuring Self-Esteem with Passive Sensing." *PervasiveHealth*, May. <https://doi.org/10.1145/3421937.3421952>.

Explanation in the context of the Case Study:

Abraham Maslow's Hierarchy of Needs can be applied to different ecosystems and markets, providing unique insights into how businesses affect individuals in the context of unmet needs. According to Maslow, unsatisfied needs are the drivers for people's choices and how they behave. To move up the hierarchy, a set of basic needs must be met. The framework can therefore be used to assess the opportunity set for companies such as AGT. In the case at hand, psychological needs are the most basic needs, which from the perspective of AGT, means building basic or alternative infrastructures through solar energy, allowing individuals to move up the latter by utilizing AGT's products.

Appendix O: Business: Three Basic Conditions**BUSINESS: THREE BASIC CONDITIONS**

1. Revenue > Costs = Profits
2. Profits can be maintained for a sustained period
3. Profits are = or > than other similar activities of equivalent risk

Source: Alfaiate, Filipe. 2022. "The Bottom of the Pyramid." Class lecture. 2590 Leading Impact Enterprises in International Development, Nova School of Business and Economics, Lisbon, 2022.

Explanation in the context of the Case Study:

The three basic conditions of businesses can be linked to for-profit enterprises. Although companies such as AGT have a major focus on impact creation, it is nevertheless evident that these three conditions are being met, categorizing AGT as a for-profit social enterprise. The goal which can be seen throughout the case, is for AGT to be commercially viable while having a social purpose.

Appendix P: Pull/ Push Approach to Inclusive Market Systems Development

Push Approach	Pull Approach:
<ul style="list-style-type: none"> • Top down with major focus on business. • Not suitable in the long-term. • Poverty as a resource problem. 	<ul style="list-style-type: none"> • Building the basis of the market • Focus on both business and economic growth and development of the country. • More effective at triggering sustainable development. • Often originated by innovator on the ground who are responding to the struggles of everyday consumers or specific market demand. • More inquisitorial/investigative approach to problem solving as opposed to a more advocacy or policy approach. Innovators are there to learn and then solve problems in a sustainable manner, as opposed to pushing. • Pull Strategies focus on creating or responding to the needs of a market fist. It is then the job of the market to pull in the resources it needs to survive.

Source: Alfaiate, Filipe. 2022. "The Bottom of the Pyramid." Class lecture. 2590 Leading Impact Enterprises in International Development, Nova School of Business and Economics, Lisbon, 2022.

Garloch, Anna. 2015. "A Framework for a Push/Pull Approach to Inclusive Market Systems Development." ACIDI/VOCA.

Appendix Q: The Three Basic Principles of Affordability, Access, and Availability

Affordability
<ul style="list-style-type: none"> • Not the same as cheap product and services • No sacrifice in quality or efficacy • Examples: single serve packaging, novel purchasing schemes
Access
<ul style="list-style-type: none"> • Take into account where the poor live and their work patterns • Travelling impediments • Last Mile Distribution
Availability
<ul style="list-style-type: none"> • Take into consideration the variability in the cash flows of BOP consumers

Source: Alfaiate, Filipe. 2022. "The Bottom of the Pyramid." Class lecture. 2590 Leading Impact Enterprises in International Development, Nova School of Business and Economics, Lisbon, 2022.

Appendix R: The 12 Principles of Innovation

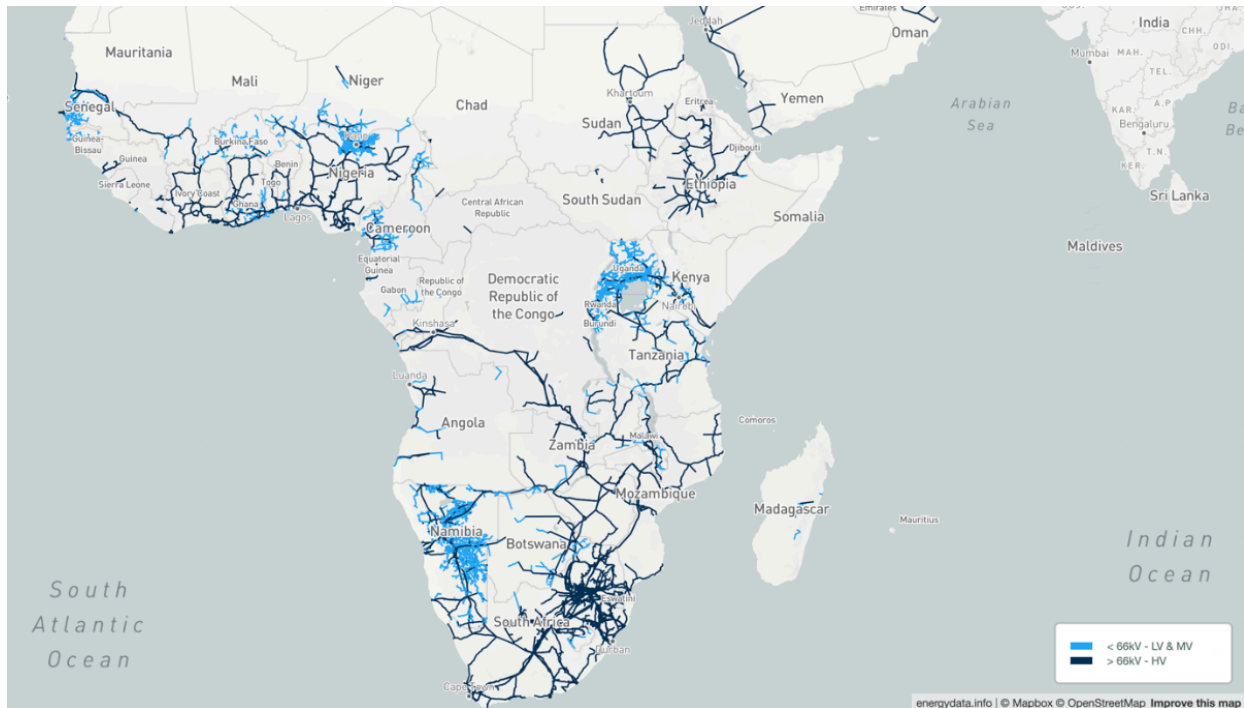
12 PRINCIPLES OF INNOVATION FOR BOTTOM OF THE PYRAMID MARKETS

Prahalad provides the following building blocks for creating products and services for Bottom of the Pyramid markets:

1. Focus on (quantum jumps in) **price performance**.
2. **Hybrid solutions**, blending old and new technology.
3. **Scaleable and transportable operations** across countries, cultures and languages.
4. Reduced resource intensity: **eco-friendly products**.
5. Radical product **redesign from the beginning**: marginal changes to existing Western products will not work.
6. Build logistical and manufacturing **infrastructure**.
7. **Deskill** (services) work.
8. **Educate** (semiliterate) customers in product usage.
9. Products must work in **hostile environments**: noise, dust, unsanitary conditions, abuse, electric blackouts, water pollution.
10. **Adaptable user interface** to heterogeneous consumer bases.
11. **Distribution methods** should be designed to reach both highly dispersed rural markets and highly dense urban markets.
12. Focus on **broad architecture**, enabling quick and easy incorporation of new features.

Source: Prahalad, Coimbatore Krishna, and Coimbatore K. Prahalad. 2005. *The Fortune at the Bottom of the Pyramid*. Wharton School Pub.

Appendix S: Existing Electricity Grid Network in SSA



Source: “Africa Electricity Grids Explorer.” n.d. <https://africagrid.energydata.info/>.

Appendix T: Model Energy Score

Country	Energy											Energy score
	Solar Potential						Electrification					
	GHI (kWh/m ²)	GHI Score	PVout (kWh/kWp)	PVOUT Score	PVout SI	PVOUT SI SCORE	NER %	NER Score	Solar Energy Generation (Billion KW)	Solar Energy Generation Score	Weight	
Angola	5.747	0,688	4659	0,741	1,32	0,619	48,2	0,561	0,020	0,003	0,6032	
Benin	5.325	0,487	4198	0,575	1,41	0,405	42	0,628	0,010	0,002	0,4694	
Botswana	6.067	0,840	5107	0,902	1,21	0,881	73,7	0,285	0,010	0,002	0,6944	
Burkina Faso	5.807	0,716	4570	0,709	1,26	0,762	19	0,878	0,120	0,018	0,6756	
Burundi	5.190	0,423	4172	0,565	1,32	0,619	10,2	0,973	0,010	0,002	0,5285	
Cabo Verde	5.636	0,635	4682	0,749	1,34	0,571	95,5	0,049	0,010	0,002	0,5027	
Cameroon	5.296	0,474	4277	0,603	1,44	0,333	65,4	0,375	0,020	0,003	0,4231	
Central African Republic	5.697	0,664	4467	0,672	1,41	0,405	15,7	0,913	0,000	0,000	0,5980	
Chad	6.262	0,932	4837	0,805	1,38	0,476	11,3	0,961	0,000	0,000	0,7430	
Comoros	5.054	0,359	4286	0,606	1,20	0,905	87,9	0,131	0,000	0,000	0,4326	
Congo, Democratic Republic of	5.188	0,422	4256	0,596	1,30	0,667	20,8	0,858	0,010	0,002	0,5256	
Congo, Republic of	4.860	0,267	3767	0,420	1,28	0,714	49,7	0,545	0,000	0,000	0,3871	
Cote d'Ivoire	5.055	0,359	4000	0,503	1,41	0,405	71,1	0,313	0,010	0,002	0,3594	
Djibouti	6.058	0,835	4797	0,790	1,36	0,524	42	0,628	0,000	0,000	0,6628	
Equatorial Guinea	4.600	0,143	3667	0,384	1,37	0,500	66,8	0,360	0,000	0,000	0,2750	
Eritrea	6.072	0,842	4895	0,826	1,43	0,357	52,5	0,515	0,020	0,003	0,6200	
Eswatini (Formerly Known as Swaziland)	4.849	0,262	4319	0,618	1,16	1,000	82,9	0,185	0,000	0,000	0,4239	
Ethiopia	5.850	0,737	4695	0,754	1,58	0,000	54,2	0,496	0,040	0,006	0,5213	
Gabon	4.544	0,117	2602	0,000	1,39	0,452	91,8	0,089	0,000	0,000	0,1220	
Gambia, The	5.748	0,688	4569	0,708	1,34	0,571	63,7	0,393	0,000	0,000	0,5627	
Ghana	5.096	0,379	4020	0,511	1,39	0,452	86,3	0,148	0,060	0,009	0,3512	
Guinea	5.573	0,605	4437	0,661	1,38	0,476	46,8	0,576	0,020	0,003	0,5352	
Guinea-Bissau	5.604	0,620	4458	0,668	1,39	0,452	35,8	0,696	0,000	0,000	0,5562	
Kenya	5.780	0,703	4504	0,685	1,38	0,476	76,5	0,255	0,010	0,002	0,5272	
Lesotho	5.541	0,590	5135	0,912	1,17	0,976	50,4	0,537	0,000	0,000	0,6615	
Liberia	4.876	0,274	3883	0,461	1,41	0,405	29,8	0,761	0,000	0,000	0,3861	
Madagascar	5.625	0,630	4758	0,776	1,31	0,643	35,1	0,703	0,020	0,003	0,6167	
Malawi	5.594	0,615	4601	0,720	1,38	0,476	14,2	0,930	0,170	0,026	0,6087	
Mali	6.018	0,816	4676	0,747	1,24	0,810	53,4	0,505	0,030	0,005	0,6700	
Mauritania	6.038	0,826	4749	0,773	1,20	0,905	47,7	0,567	0,140	0,021	0,7051	
Mauritius	5.013	0,339	4215	0,581	1,36	0,524	99,6	0,004	0,160	0,024	0,3456	
Mozambique	5.382	0,514	4435	0,660	1,23	0,833	31,5	0,742	0,070	0,011	0,5825	
Namibia	6.405	1,000	5379	1,000	1,17	0,976	55,2	0,485	0,380	0,057	0,8249	
Niger	6.265	0,934	4837	0,805	1,24	0,810	18,6	0,882	0,000	0,008	0,7824	
Nigeria	5.436	0,540	4298	0,611	1,40	0,429	59,5	0,439	0,050	0,008	0,4726	
Rwanda	5.076	0,369	4102	0,540	1,22	0,857	48,7	0,556	0,060	0,009	0,4771	
Sao Tome and Principe	4.298	0,000	3468	0,312	1,36	0,524	78,5	0,233	0,000	0,000	0,1915	
Senegal	5.798	0,712	4584	0,714	1,28	0,714	68	0,347	0,470	0,071	0,5938	
Seychelles	5.628	0,631	4248	0,593	1,22	0,857	100	0,000	0,070	0,011	0,4987	
Sierra Leone	5.119	0,390	4986	0,858	1,30	0,667	27,5	0,785	0,010	0,002	0,5690	
Somalia	6.028	0,821	4762	0,778	1,50	0,190	49,3	0,549	0,030	0,005	0,5932	
South Africa	5.629	0,632	5004	0,865	1,23	0,833	89,3	0,116	6,650	1,000	0,6797	
South Sudan	5.679	0,655	4457	0,668	1,40	0,429	7,7	1,000	0,000	0,000	0,6107	
Sudan	6.323	0,961	4943	0,843	1,42	0,381	61,8	0,414	0,030	0,005	0,6668	
Tanzania	5.657	0,645	4507	0,686	1,31	0,643	42,7	0,621	0,060	0,009	0,5877	
Togo	5.218	0,437	4124	0,548	1,41	0,405	55,7	0,480	0,020	0,003	0,4229	
Uganda	5.643	0,638	4462	0,670	1,24	0,810	45,2	0,594	0,150	0,023	0,6036	
Zambia	5.883	0,752	4828	0,802	1,39	0,452	46,7	0,577	0,150	0,023	0,6204	
Zimbabwe	5.781	0,704	4861	0,813	1,27	0,738	49	0,553	0,040	0,006	0,6439	
Weight		35%		25%		15%		15%		10%	100%	

Source: By authors.

Appendix V: Model: Political Score

Country	Governance and Institutional Effectiveness										Civil and Public Rights		Security and Stability		Public of Risk Score
	Rule of law Score	Government effectiveness Score	Voice and accountability Score	Regulatory quality Score	Control of corruption (2.5) Score	Corruption perceptions Score	Public integrity Score	Press freedom Score	People's state index Score	Public stability (2.5) Score	Absence of Violence Score	Public of Risk Score			
Angola	-0.51	0.420	-1.06	0.381	-0.64	0.380	-0.64	0.380	86.5	0.333	-0.71	0.538	21	0.154	0.138
Burkina Faso	-0.59	0.535	-0.21	0.615	-0.24	0.589	-0.43	0.485	69	0.300	-0.10	0.650	31	0.372	0.190
Burundi	-0.64	0.626	0.26	0.681	0.46	0.611	0.61	0.611	66	0.628	0.38	1.000	42	0.906	0.611
Cameroon	-0.64	0.583	-0.73	0.441	-0.11	0.634	-0.47	0.432	42	0.504	-1.64	0.284	8	0.081	0.422
Central African Republic	-1.25	0.312	-1.31	0.261	-1.41	0.181	-0.98	0.281	17	0.099	-1.36	0.391	11	0.140	0.179
Chad	-0.26	0.884	0.66	0.689	0.68	1.000	0.77	0.689	106	0.828	0.95	0.978	82	0.936	0.977
Cote d'Ivoire	-1.10	0.373	-0.88	0.381	-1.16	0.268	-0.92	0.381	26	0.241	-1.41	0.347	11	0.134	0.243
DRC	-1.67	0.191	-1.64	0.137	-1.69	0.130	-1.69	0.130	14	0.000	-2.10	0.156	4	0.093	0.108
Egypt	-1.31	0.296	-1.62	0.211	-1.42	0.176	-1.55	0.224	19	0.121	-1.34	0.346	9	0.091	0.138
Ethiopia	-1.22	0.334	-1.79	0.087	-1.24	0.415	-1.25	0.181	19	0.312	-0.23	0.669	39	0.442	0.382
Ghana	-1.70	0.187	-1.72	0.110	-1.70	0.224	-1.62	0.134	39	0.138	-1.61	0.292	4	0.093	0.132
Guinea	-1.44	0.360	-1.55	0.187	-1.24	0.260	-1.37	0.120	21	0.155	-0.61	0.546	46	0.626	0.397
Guinea-Bissau	-0.61	0.522	-0.51	0.515	-0.47	0.509	-0.26	0.522	37	0.413	-0.95	0.473	26	0.291	0.433
Kenya	-1.01	0.461	-0.83	0.498	-0.30	0.220	-0.87	0.333	39	0.330	-0.71	0.538	27	0.262	0.309
Madagascar	-1.20	0.341	-1.46	0.288	-1.72	0.071	-1.71	0.067	17	0.084	-0.26	0.653	43	0.488	0.312
Mali	-1.57	0.223	-1.68	0.124	-1.93	0.000	-2.27	-0.111	124	0.138	-1.01	0.456	15	0.163	0.132
Mozambique	-0.64	0.546	-0.73	0.441	-0.30	0.220	-0.68	0.435	38	0.310	-0.63	0.728	38	0.448	0.385
Nigeria	-0.61	0.529	-0.61	0.482	-0.67	0.300	-0.65	0.465	38	0.448	-0.67	0.517	5	0.047	0.288
Rwanda	-0.70	0.500	-0.78	0.435	-0.89	0.362	-0.81	0.338	29	0.293	-0.09	0.708	50	0.578	0.390
Senegal	-0.98	0.599	-0.84	0.472	-0.93	0.638	-0.87	0.338	34	0.379	-0.18	0.783	48	0.536	0.314
Sierra Leone	-0.69	0.607	-0.55	0.435	-0.47	0.485	-0.20	0.542	43	0.334	-0.07	0.751	44	0.508	0.373
Tanzania	-1.11	0.363	-0.92	0.378	-0.99	0.328	-0.96	0.288	100	0.229	-0.97	0.467	17	0.184	0.229
Togo	-1.41	0.264	-1.62	0.213	-1.24	0.199	-1.26	0.187	120	0.141	-0.33	0.656	31	0.246	0.342
Uganda	-0.30	0.599	-0.33	0.575	-0.37	0.544	-0.45	0.458	43	0.344	-0.50	0.434	15	0.163	0.427
Zambia	-0.41	0.592	-0.51	0.381	-0.62	0.466	-0.74	0.381	37	0.431	-0.22	0.672	42	0.477	0.338
Zimbabwe	-0.91	0.427	-1.38	0.224	-0.92	0.166	-0.96	0.281	26	0.241	-0.24	0.667	38	0.467	0.431
Botswana	-0.24	0.646	-1.25	0.234	-0.27	0.578	-0.82	0.334	26	0.341	-0.64	0.557	26	0.291	0.439
Benin	-0.84	0.446	-0.77	0.478	-0.61	0.460	-0.79	0.344	34	0.379	-0.11	0.702	42	0.477	0.320
Burkina Faso	-0.95	0.484	-1.22	0.278	-0.78	0.401	-0.82	0.481	25	0.276	-0.33	0.686	1	0.066	0.365
Cameroon	-0.27	0.637	-0.63	0.508	-0.64	0.404	-0.52	0.282	45	0.569	-0.67	0.549	27	0.262	0.318
Chad	-0.81	0.500	-0.95	0.401	-0.66	0.362	-0.77	0.300	58	0.455	-0.86	0.367	29	0.366	0.490
Cote d'Ivoire	-1.04	0.392	-0.77	0.438	-0.61	0.460	-0.78	0.388	26	0.241	-1.23	0.396	11	0.134	0.137
Egypt	-0.30	0.638	-0.64	0.706	-0.67	0.471	-0.40	0.409	49	0.488	-0.63	0.683	64	0.798	0.293
Ethiopia	-0.40	0.596	-0.61	0.482	-0.39	0.537	-0.75	0.338	32	0.345	-1.62	0.290	10	0.190	0.190
Guinea	-0.86	0.440	-1.36	0.211	-0.64	0.440	-0.93	0.288	24	0.207	-1.78	0.248	4	0.081	0.292
Guinea-Bissau	-0.70	0.507	-0.26	0.773	-0.07	0.697	-0.60	0.498	52	0.672	-0.17	0.779	48	0.542	0.541
Kenya	-0.20	0.500	-0.73	0.441	-0.79	0.397	-0.93	0.298	62	0.517	-0.60	0.696	66	0.794	0.628
Madagascar	-0.86	0.408	-0.96	0.296	-0.93	0.190	-0.91	0.305	41	0.334	-0.17	0.686	41	0.461	0.465
Mali	-0.34	0.631	-0.34	0.600	-0.34	0.485	-0.42	0.415	183	1.000	-0.76	0.460	73	0.832	0.628
Mozambique	-0.82	0.462	-1.21	0.334	-0.98	0.492	-0.96	0.288	44	0.379	-0.16	0.688	41	0.468	0.550
Nigeria	-0.27	0.600	-1.05	0.300	-1.25	0.300	-1.28	0.300	12	0.000	-2.68	0.000	1	0.000	0.000
Rwanda	-1.11	0.764	-0.92	0.479	-0.79	0.368	-0.97	0.348	43	0.334	-0.71	0.538	20	0.221	0.436
Tanzania	-0.23	0.538	-1.64	0.137	-1.47	0.110	-1.47	0.110	22	0.174	-1.94	0.202	5	0.047	0.133
Togo	-0.52	0.507	-0.61	0.475	-0.71	0.431	-0.63	0.388	38	0.448	-0.44	0.612	37	0.430	0.431
Uganda	-0.54	0.545	-0.55	0.448	-0.79	0.397	-0.63	0.398	42	0.317	-0.80	0.514	21	0.233	0.413
Zambia	-0.93	0.611	-0.97	0.485	-0.92	0.397	-0.98	0.448	100	0.229	-0.86	0.497	17	0.188	0.317
Zimbabwe	-0.94	0.585	-0.82	0.411	-0.97	0.344	-0.92	0.452	31	0.362	-0.96	0.748	16	0.296	0.497
Zimbabwe	-1.25	0.322	-1.24	0.271	-1.34	0.275	-1.37	0.131	23	0.190	-1.03	0.451	17	0.181	0.283
Weight		8%		8%		8%		8%	12%		12%		12%	100%	100%

Source: By authors.

Appendix W: Model: Final Score

Country	Energy score	Economic Score	Business Potential	Political Risk Score
Angola	0,6032	0,3048	0,4838	0,363
Benin	0,4694	0,3613	0,4262	0,587
Botswana	0,6944	0,4326	0,5897	0,789
Burkina Faso	0,6756	0,2924	0,5223	0,464
Burundi	0,5285	0,3645	0,4629	0,211
Cabo Verde	0,5027	0,4592	0,4853	0,845
Cameroon	0,4231	0,3751	0,4039	0,284
Central African Republic	0,5980	0,1975	0,4378	0,175
Chad	0,7430	0,2172	0,5327	0,222
Comoros	0,4326	0,3194	0,3873	0,378
Congo, Democratic Republic of	0,5256	0,3744	0,4651	0,196
Congo, Republic of	0,3871	0,4158	0,3986	0,301
Cote d'Ivoire	0,3594	0,5495	0,4354	0,479
Djibouti	0,6628	0,3026	0,5187	0,323
Equatorial Guinea	0,2750	0,4739	0,3546	0,233
Eritrea	0,6322	0,2831	0,4926	0,159
Eswatini (Formerly Known as Swaziland)	0,4239	0,3636	0,3998	0,375
Ethiopia	0,5213	0,3016	0,4334	0,323
Gabon	0,1220	0,5351	0,2872	0,370
Gambia, The	0,5627	0,3505	0,4778	0,516
Ghana	0,3512	0,5024	0,4117	0,645
Guinea	0,5352	0,3352	0,4552	0,350
Guinea-Bissau	0,5562	0,3429	0,4709	0,374
Kenya	0,5272	0,3810	0,4687	0,455
Lesotho	0,6615	0,2532	0,4982	0,541
Liberia	0,3861	0,3872	0,3865	0,465
Madagascar	0,6167	0,2739	0,4796	0,453
Malawi	0,6087	0,2604	0,4694	0,538
Mali	0,6700	0,2861	0,5164	0,319
Mauritania	0,7051	0,5006	0,6233	0,389
Mauritius	0,3456	0,5505	0,4276	0,770
Mozambique	0,5825	0,3533	0,4908	0,379
Namibia	0,8249	0,4145	0,6607	0,723
Niger	0,7824	0,3088	0,5930	0,430
Nigeria	0,4726	0,3670	0,4304	0,342
Rwanda	0,4771	0,4757	0,4765	0,557
Sao Tome and Principe	0,1915	0,5578	0,3380	0,617
Senegal	0,5938	0,3587	0,4998	0,598
Seychelles	0,4987	0,5452	0,5173	0,780
Sierra Leone	0,5690	0,2605	0,4456	0,520
Somalia	0,5932	0,2495	0,4557	0,085
South Africa	0,6797	0,6762	0,6783	0,630
South Sudan	0,6107	0,1932	0,4437	
Sudan	0,6668	0,3152	0,5262	0,201
Tanzania	0,5877	0,4390	0,5282	0,439
Togo	0,4229	0,3713	0,4023	0,429
Uganda	0,6036	0,3900	0,5182	0,373
Zambia	0,6204	0,3819	0,5250	0,502
Zimbabwe	0,6439	0,3648	0,5323	0,311
Weight	60%	40%	100%	-

Source: By authors.

Appendix X: External in-depth interview no.4 with Pierre Malbec

Question 1: *AGT wants to diversify its activities, business units and expand abroad, what is your take on their recent shift in strategy?*

Pierre:

I guess that they are thinking on which market to move into or to grow. There has to be, I think, a key decision around each of the segment, because if you target C&I customers, so industrial players, corporates probably will look at it from a very different perspective because the first business model that you described [Impactsites in rural areas] sounds a lot like NGO type project, low revenue, low margin and slow growth, which is which is fine.

It depends on how the company wants to grow and what they want to achieve, but it sounds very conflicting to pursue those different segments because a lot of pure renewable energy players are focusing on other selling power to governments through step's fitting tariff.

For instance, all that targeting commercial and industrial customers, corporates for their power needs as part of the commitment towards NET 0 carbon paragraph. The company I work for, Amazon, is committed to be 100% renewables by 2025.

And with that goal, we are contracting with companies that are able to provide green energy solutions, so solar very often and we just buy the electricity that they produce. I guess the first step is really to define what the long-term strategy of the company is. I would say pick a battle because those segments are extremely different and you don't go in the same markets.

If you want to deploy those solutions because for C&I you'll be looking at uh leading markets in, in app leading countries in Africa where there is a strong industrial growth with a lot of companies moving into those markets you need to identify who within those companies have made commitments pledged towards other sustainability policies and are committed to buy green power. For instance, for their operations, and then you narrow down to which market has the highest growth. You analyse the competitive landscape. Because obviously if you go to Nigeria or if you go to Chad for the first segment that works, there'll be a lot of NGO type development, but you will struggle to find strong commercial industrial players for the other part of the business. You'll probably go to Kenya or South Africa or North Africa to Morocco for instance. So it really depends on what product you want to push and for which customer?

Question 2: *Would AGT benefit from partnering with non-renewable energy stakeholders?*

Pierre:

For the first part of the business then did you look into the mining sector, in the sense that very often large mining groups operating in Africa have a CSR campaign and there could be the finances of those product for the communities in which they operate, but also, they could use their own. I mean those products on their side could be used to power the camps for instance where the workers are and that could be a good expansion of the business while still being connected. If we look at West Africa, Guinea, for instance, is a country where there are a lot of needs from rural populations, NGO type project that could either be solved through to the local communities directly or be sponsored by the large mining groups that operate in those markets. That could be an area of growth as well.

Question 3: *We are currently working on the mapping of a model that will select the best countries in SSA to enter based on economic and political criteria. Do you have any other categories and criteria that could be helpful for our research?*

Pierre:

I think the DDT electrification rate is the key one. I don't think that there are major differences in terms of solar resources or solar rotation. I mean, across Africa it's quite favourable. I don't think that it will be a key messy differentiator in the way you approach those countries. Of course, radiation it would be better in Chad than in some parts of South Africa, but it's still high-capacity factors, so it's not a blocker. I think it's more the electrification rate and also the GDP per capita.

Question 4: *how important do you think the political risk is when operating in SSA countries like?*

Pierre:

Political risk is something to consider. That is why I was asking about the business model and how to secure the payments because if you are selling to individuals in remote villages and there is no credit rating. There is no security on the fact that they're going to pay the bill at the end of the day. To me, that's more an important aspect on how to secure payments right beyond the political risk. Because even if you operate in a very safe, politically stable market, if you don't make sure that whoever consumed that electricity is paying uh for you to stay consumed, you've got a bigger problem than the political risk.

To me this is key and that's why I was curious on how they address that risk. If they don't, they should maybe have a sponsor on each project at the at the community level or backed by the government or backed by an NGO locally or backed by a mining company, for instance, to meet that is really key. If you want one way to address the political risk is to look at markets in which international companies are developing long term business and investing in. long term assets like mining. Large established international mining companies will invest in countries where they believe that there is a relatively stable long term political scene and therefore their investment is safe in the long term, so I would really do a landscaping around who is operating and where, how much they've invested and that gives you another prism around the political risk. If BHP Billiton invested billions in Guinea, it's probably because they have assessed that it's safe to do so or that they're able to take the risk. To me that would clear the political risk aspect and it can be mining, oil and gas, cement plant and cement industry, large, expensive, and long-term assets that are being developed by international players in those companies a good signal.

Question 5: *Do you think foreign companies should take into consideration now this anti-European feeling growing in Africa when they want to enter a market? Is it something companies should be afraid of?*

Pierre:

With regards to Amazon, I work for the cloud side of the business, AWS Amazon Web Services, we build data centres, and we provide cloud solutions to our customers and the only presence we have in Africa is in South Africa. We moved there because our customers were in demand and therefore, we invested in the country to provide solution to our customers in the country. The demand signal was so strong and there was no questioning. We had long term perspective and it made sense at the time to do that investment and we're still growing. So putting aside Amazon and what? What we are doing, I think it's yes. There may be resentment across the board and against international companies moving. It all comes down to which problem companies is solving if there is. A strong problem statement, and even if it's a foreign

company coming in, they solve it. There is resentment because there is a sentiment of inequity, and we see that repeatedly across all those markets. In this context of AGT, they are solving a need, right? A need for electrification, a need for power.

They are bringing a solution, so I don't think that what's happening across all those markets is an issue for companies that are bringing real solutions on the ground that is benefiting the population. It all depends on your approach: either establishing your presence in Africa to take the resources or making a profit or bringing a real solution that will help populations.

Question 6: *You said it is a good opportunity to work with the big mining and oiling companies, but will this not become an “image” problem?*

Pierre:

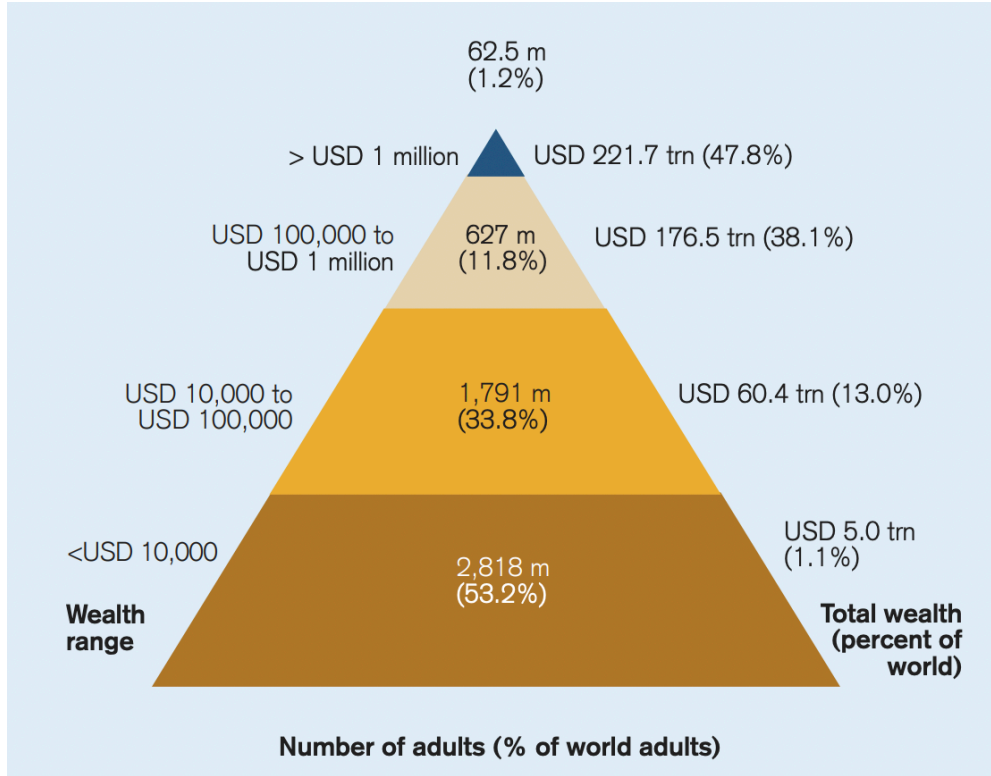
Let's take an example of 1 containerized solution for evaluation in Liberia, that's specific. Village can't afford to lease it, and the population can't even afford to pay for the electricity. And you've got the neighbour, the mining company, that say “we're going to buy it and you'll get the electricity for free”. I don't think anyone will complain, right? There is sometimes controversy around the fact that those big mining companies are greenwashing in a way or buying their way into those markets. But at the end of the day, as long as it's solved problem for the local population, it should be framed in a way that it brings net value to those communities. It's all down to how you convey the message and how you advertise on that. But I don't see that as a real problem.

Question 7: *Our model selected the four following countries: Botswana, Burkina Faso, Mauritania and Namibia, are you familiar with these markets? If so, would you have some input that could help us?*

Pierre:

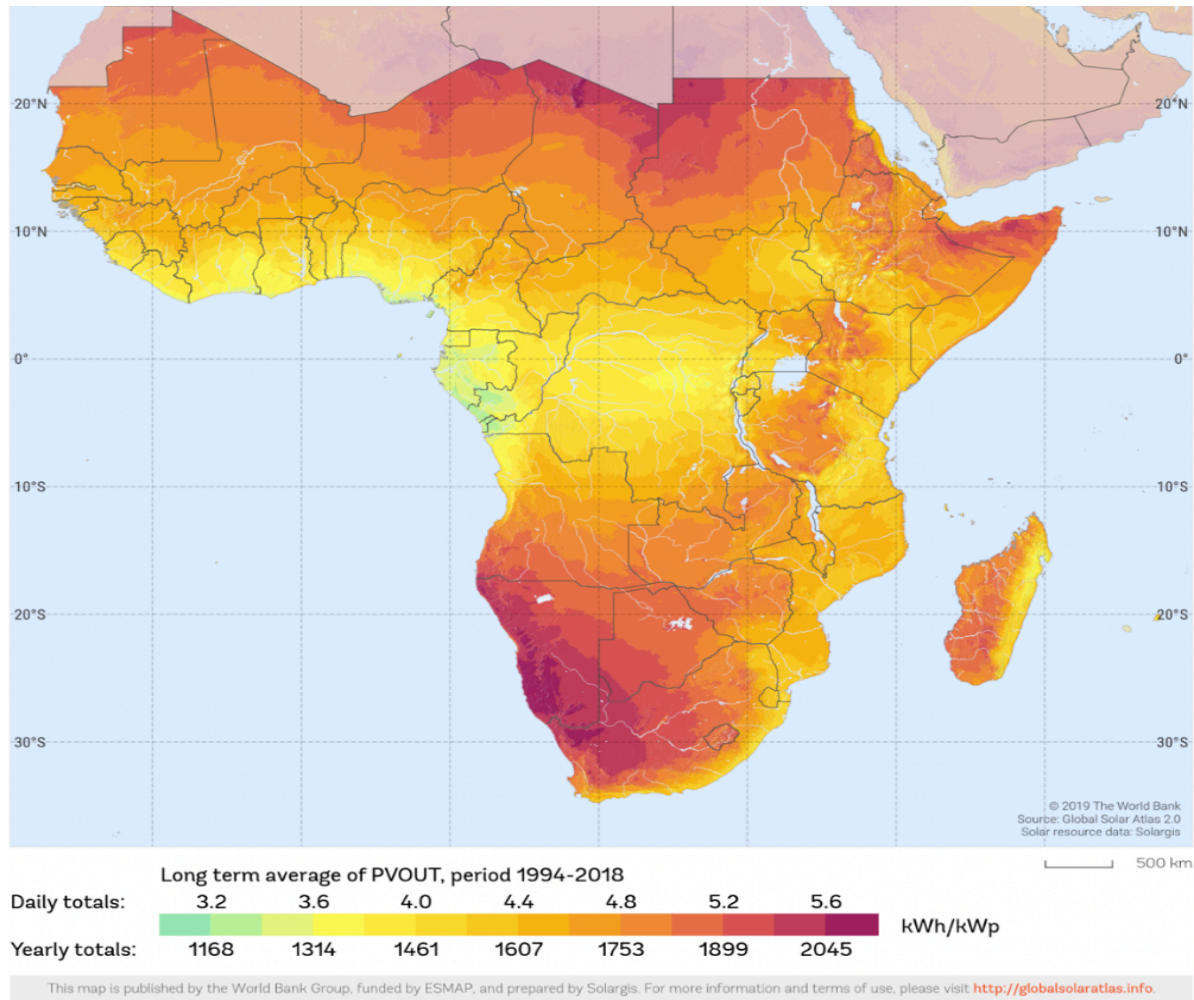
I won't be able to comment on Botswana, because if never been there, I have no valuable information. Burkina Faso is a mining country; I would characterize it as a relatively stable politically but still with still with large operating companies and mostly in the mining. Same goes with Namibia, strong mining industry. Lastly, Mauritania also is a huge mining country. To me that would be an angle for growth because the mining industry ticks a few boxes and confirms the political stability of the country, it helps to get those projects financed or sponsored or guaranteed.

Appendix Y: The Global Wealth Pyramid 2021

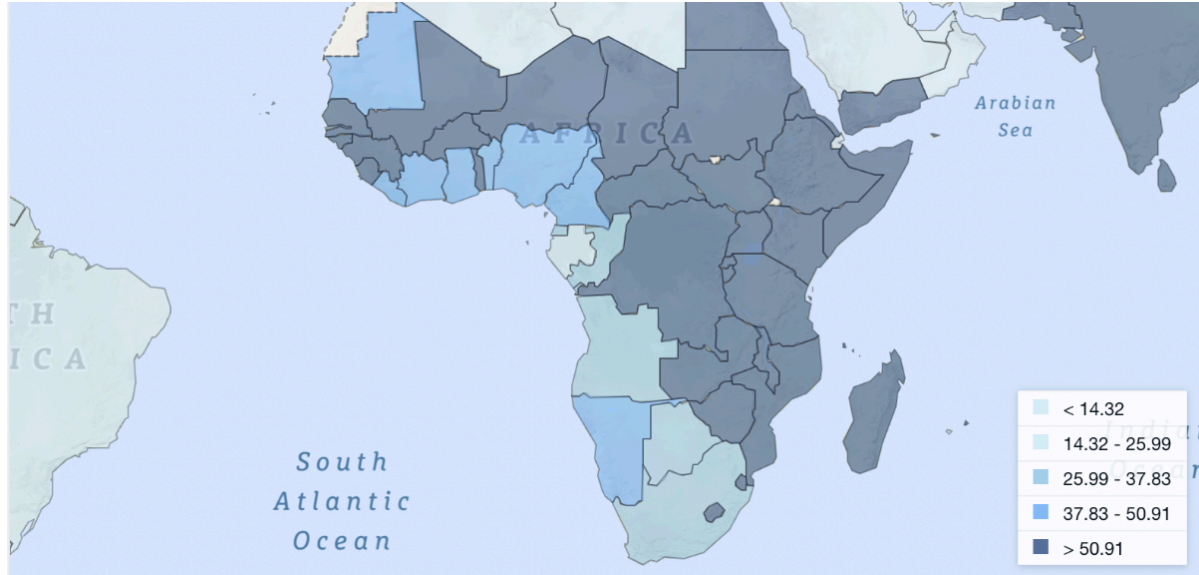


Source: Credit Suisse Research Institute. 2022. “Global Wealth Report 2022: Leading Perspectives to Navigate the Future.” *Credit Suisse*. Credit Suisse.

Appendix Z: Photovoltaic Power Potential sub-Saharan Africa

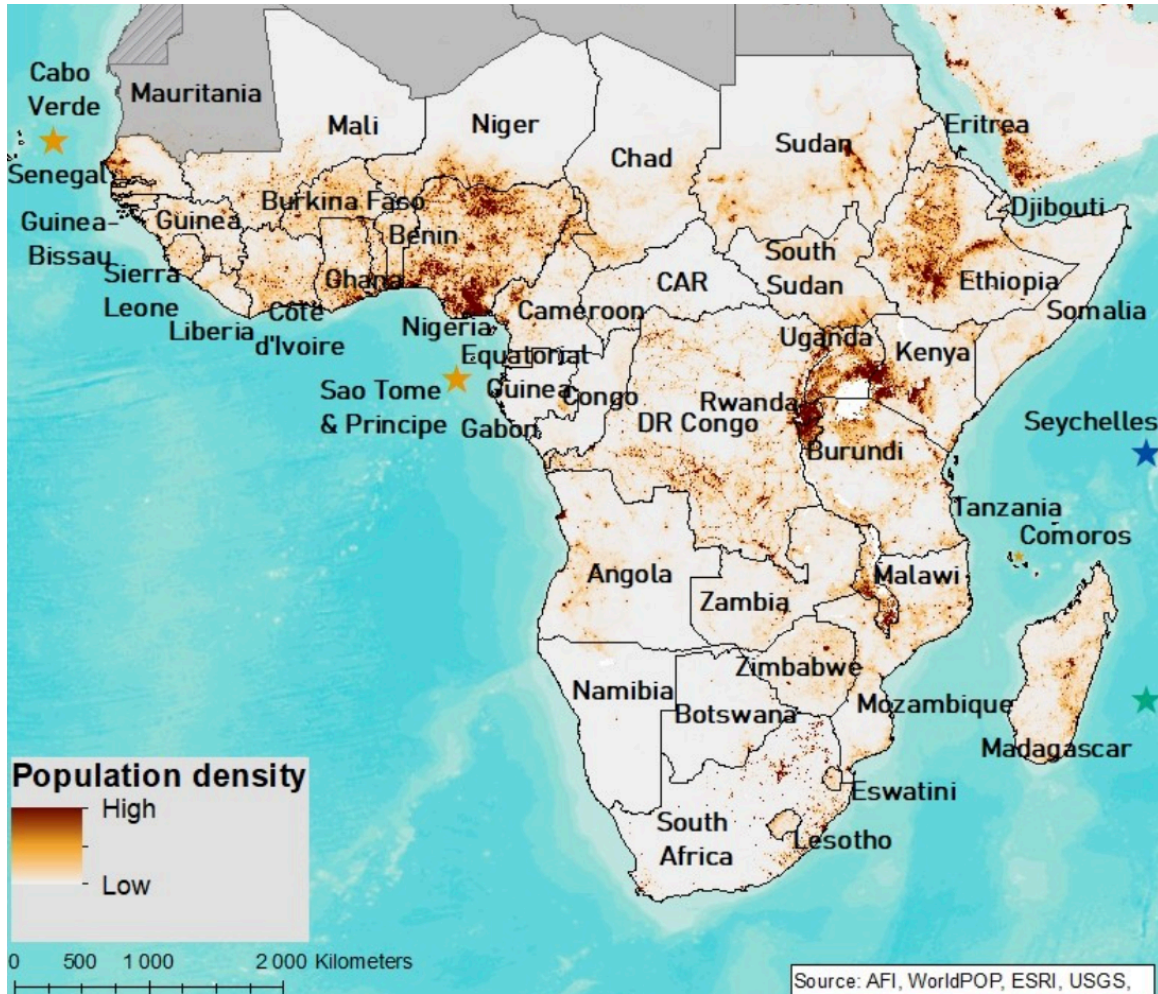


Source: Solargis. n.d. “Global Solar Atlas.” The World Bank Group. <https://globalsolaratlas.info/download/sub-saharan-africa>.

Appendix AA: Rural Population in % of Total Population 2022

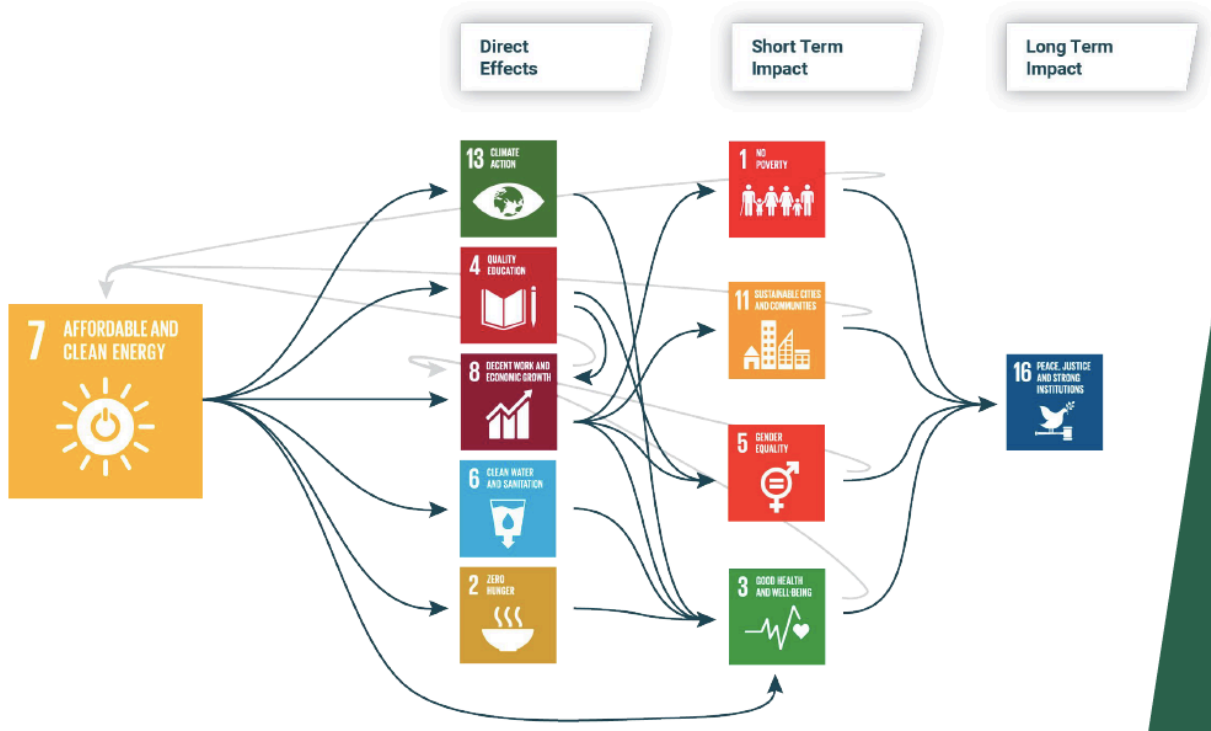
Source: “World Bank Open Data.” n.d. World Bank Open Data. <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?end=2022&locations=ZG&start=2000&type=shaded&view=map&year=2022>.

Appendix BB: Population Density in SSA



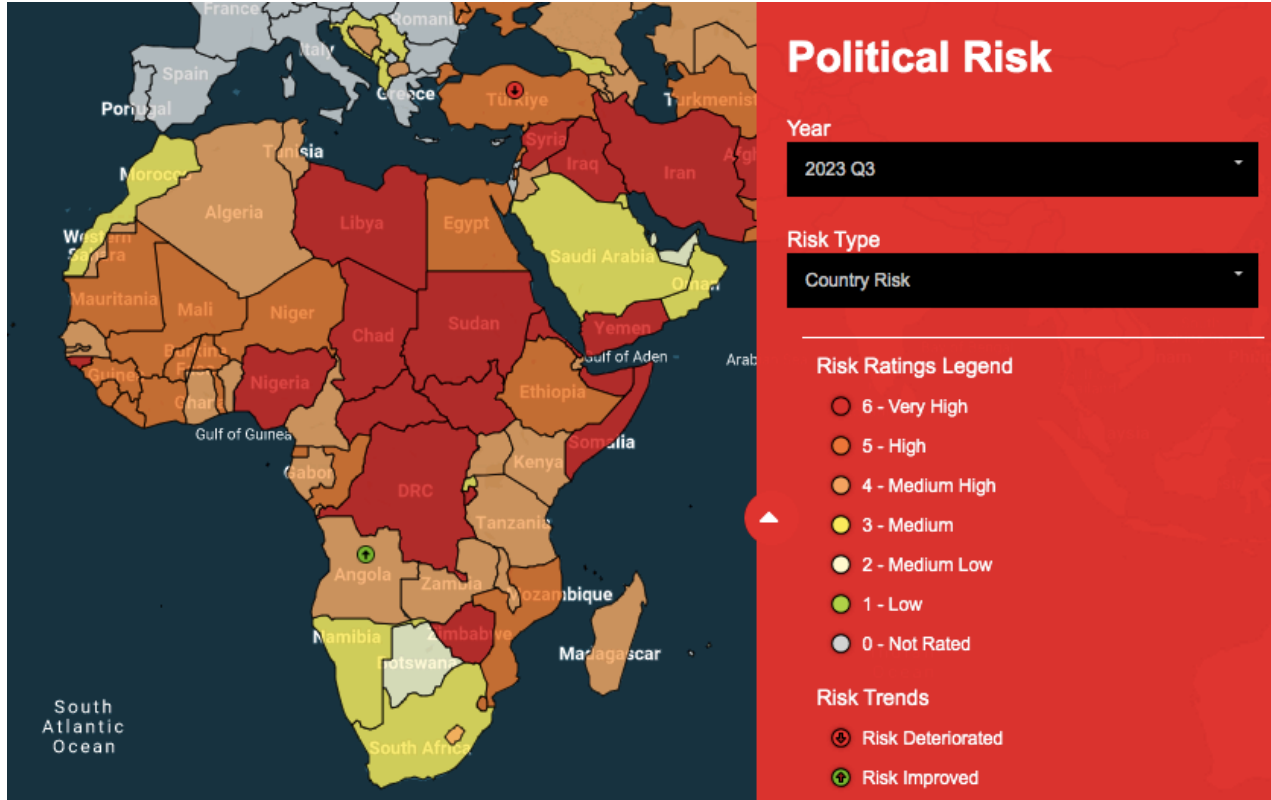
Source: Jobarteh, Mustapha. 2023. “Sub-Saharan Africa.” ISS African Futures. November 15, 2023. Accessed December 7, 2023. <https://futures.issafrica.org/geographic/regions/sub-saharan-africa/>.

Appendix CC: Electricity as the Main Driver for Sustainable Development



Source: Africa GreenTec. 2023. “Africa GreenTec Business Plan 2023.” Unpublished.

Appendix DD: The AON's Risk Map



Source: AON. 2023. "AON Risk Portal" <https://www.riskmaps.aon.co.uk/PoliticalRisk/Map>

Appendix EE: In-Depth Internal Interviews

No.	Participant	Company	Position	Length	Date
1	Enzo Cenci Theo Saur	Africa GreenTec	Senior Corporate Finance & Risk Manager Finance & Operations Manager	60 min	25.07.2023
2	Enzo Cenci Theo Saur	Africa GreenTec	Senior Corporate Finance & Risk Manager Finance & Operations Manager	30 min	12.09.2023
3	Theo Saur	Africa GreenTec	Finance & Operations Manager	30 min	17.10.2023
4	Theo Saur	Africa GreenTec	Finance & Operations Manager	30 min	03.11.2023
5	Theo Saur	Africa GreenTec	Finance & Operations Manager	60 min	08.11.2023
6	Theo Saur Lucia Kamati	Africa GreenTec	Finance & Operations Manager Senior Project Manager	60 min	15.11.2023
7	Theo Saur	Africa GreenTec	Finance & Operations Manager	60 min	22.11.2023
8	Theo Saur	Africa GreenTec	Finance & Operations Manager	30 min	12.12.2023

Source: By authors.

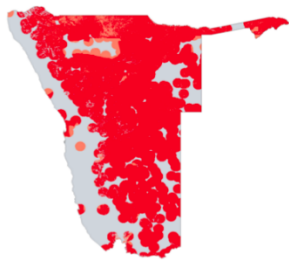
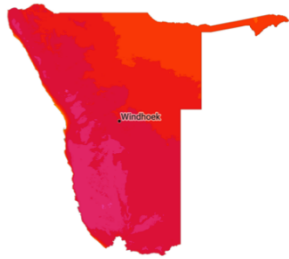
Appendix FF: In-Depth External Interviews

No.	Participant	Company	Position	Length	Date
1	Philippe Belliard	Mercer Marsh Benefits	Multinational Client Director	60 min	15.11.2023
2	Auguste Minot	FiltraLife	Head of Sales & Partner	40 min	17.11.2023
3	Curtis Brainard Sylvia Beyer Javier Jorquera Heymi Bahar	International Energy Association (IEA)	Digital Communications Manager Senior Energy Policy Analyst Energy Analyst – Renewables Senior Analyst – Renewables	120 min	28.11.2023
4	Pierre Malbec	Amazon Web Services (AWS)	Principle, Energy Strategy & Investment	30 min	12.12.2023

Source: By authors.

Appendix GG: Namibia Photovoltaic Power Potential

Namibia



The boundaries, colors, denominations and any other information shown on the maps do not imply, on the part of The World Bank, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries.

INDICATORS

Total area / Evaluated area	824,290 / 824,290 km ²
Population (2018)	2,448,255
GDP per capita (2018)	5,931 USD
HDI / rank (2017)	0.65 / 125
Electricity consumption per capita (2014)	1,653 kWh/year
PV installed capacity (2018)	79 MWp
Average theoretical potential (GHI) / rank	6.405 kWh/m ² / 2
Average practical potential, level 1 / rank	5.379 kWh/kWp / 1
PV equivalent area	0.002%
PVOUT seasonality index (country range)	1.17 (1.06 - 1.30)
LCOE average (country range)	0.08 (0.07 - 0.08)

DISTRIBUTION OF PHOTOVOLTAIC POWER OUTPUT

kWh/kWp	68.5 %	73.2 %	100.0 %	of evaluated area
over 5.6	5.4 %	5.7 %	15.0 %	
5.6 — 5.4	29.9 %	30.9 %	42.0 %	
5.4 — 5.2	19.6 %	21.9 %	26.0 %	
below 5.2	13.7 %	14.8 %	17.0 %	

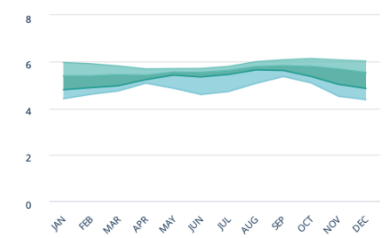
Practical potential: Level 2 Level 1 Level 0

SUMMARY STATISTICS

Maximum	6.69	Maximum	5.74
Percentile 75	6.52	Percentile 75	5.51
Median	6.41	Median	5.40
Average	6.39	Average	5.38
Percentile 25	6.26	Percentile 25	5.26
Minimum	6.01	Minimum	5.02

Theoretical potential kWh/m² GHI Practical potential, Level 1 kWh/kWp PVOUT

MONTHLY VARIATION OF PHOTOVOLTAIC POWER OUTPUT



Practical potential, Level 1: Median Percentile75 to maximum Percentile25 to percentile75 Minimum to percentile25

Source: Global Solar Atlas. 2020. “Global Photovoltaic Power Potential.” GSA.

Appendix HH: Model Sensitivity Analysis

Sensitivity Analysis for the Energy Score																	
Wind						NBK											
Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score	Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score
Burkina	0.29400	10	1.81100	0.59187	0.11141	0.08829	0.11118	0.04718	Burkina	0.19400	10	0.11100	0.05114	0.00135	0.00149	0.19441	0.00041
Madagascar	0.792100	10	1.32000	0.41904	0.15114	0.09267	0.14248	0.05037	Madagascar	0.705100	10	0.13400	0.02118	0.00105	0.00213	0.70531	0.00021
Namibia	0.82950	10	1.28700	0.45761	0.14643	0.10441	0.15111	0.04789	Namibia	0.82950	10	0.41800	0.05261	0.00714	0.00618	0.83247	0.00697

Sensitivity Analysis for the Economic Score																	
Wind						NBK											
Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score	Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score
Burkina	0.29400	-15	1.26100	1.11205	0.17141	0.18654	0.17921	0.00681	Burkina	0.29400	-15	0.05500	0.00378	0.00152	0.00018	0.29247	-0.00153
Madagascar	0.792100	-15	1.62000	1.33333	0.13714	0.20800	0.19396	0.02212	Madagascar	0.792100	-15	0.11900	0.01789	0.00105	0.00119	0.79478	0.00268
Namibia	0.82950	-15	0.98150	1.32004	0.16505	0.20012	0.18731	0.00779	Namibia	0.82950	-15	0.10300	0.00871	0.00214	0.00182	0.83061	0.00111

Sensitivity Analysis for the Economic Score																	
NBK						NBK											
Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score	Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score
Burkina	0.197019	10	0.68000	0.60184	0.01851	0.04042	0.19981	0.00272	Burkina	0.197019	10	0.68000	0.30800	0.00000	0.00000	0.42701	0.23000
Madagascar	0.488016	10	0.81000	0.41809	0.01608	0.01408	0.49181	0.00374	Madagascar	0.488016	10	0.11000	0.78000	0.01600	0.11500	0.47454	-0.01347
Namibia	0.408143	10	1.45100	0.51473	0.01875	0.05475	0.40941	0.00127	Namibia	0.408143	10	0.69000	0.47500	0.02750	0.02119	0.44181	0.03367

Sensitivity Analysis for the Economic Score																	
NBK						NBK											
Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score	Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Economic Score	Change in Economic Score
Burkina	0.197019	-15	4.91100	0.51140	0.01853	0.05114	0.19397	0.00289	Burkina	0.197019	-15	0.66000	0.12000	0.00000	0.00710	0.19951	0.00249
Madagascar	0.488016	-15	1.70000	0.56162	0.01963	0.06166	0.48664	0.00272	Madagascar	0.488016	-15	0.68000	0.17000	0.01600	0.01616	0.38811	-0.10000
Namibia	0.408143	-15	0.87500	0.51272	0.01875	0.03472	0.40741	0.00099	Namibia	0.408143	-15	0.67500	0.02750	0.00750	0.00526	0.35561	-0.05253

Sensitivity Analysis for the Political Score																	
Risk of fire						Absence of violence/terrorism											
Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Political Score	Change in Economic Score	Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Political Score	Change in Economic Score
Burkina	0.813133	10	0.52000	0.01081	0.01084	0.07187	0.81205	0.00108	Burkina	0.813133	10	95.7	1.01000	0.13248	0.00000	0.84347	0.03034
Madagascar	0.104806	10	-0.28700	0.63344	0.01091	0.01018	0.10784	0.00298	Madagascar	0.104806	10	30	0.81971	0.04279	0.04047	0.10324	-0.00156
Namibia	0.735079	10	0.19500	0.84941	0.01205	0.08724	0.73395	0.00112	Namibia	0.735079	10	78.4	0.80977	0.01787	0.02847	0.74407	0.00898

Sensitivity Analysis for the Political Score																	
Risk of fire						Absence of violence/terrorism											
Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Political Score	Change in Economic Score	Country	Original Economic Score	Percentage Change	Change in Climate	Change in Climate Score	Old change with weight	New change with weight	New Political Score	Change in Economic Score
Burkina	0.42114	-15	0.60000	0.81091	0.01084	0.04812	0.42088	0.00024	Burkina	0.42114	-15	71.0000	0.84218	0.12000	0.00768	0.31844	-0.10270
Madagascar	0.509100	-15	-0.29150	0.64881	0.01091	0.01087	0.50784	0.00126	Madagascar	0.509100	-15	22.40000	0.26079	0.03419	0.50819	0.19151	-0.31751
Namibia	0.132181	-15	0.10500	0.82082	0.01205	0.05611	0.13207	0.00011	Namibia	0.132181	-15	14.40000	0.62931	0.01797	0.04974	0.13117	-0.00691

Source: By authors.

Appendix II: Model Pre-Selection

num_order	country_name	Impact_sites			business_unit			residential			AGT Expansion Focus
		Expansion Focus	Pipeline	Active	Expansion Focus	Pipeline	Active	Expansion Focus	Pipeline	Active	
1	Angola										x
2	Benin										
3	Botswana										x
4	Burkina Faso										
5	Burundi										
6	Cabo Verde										
7	Cameroon										x
8	Central African Republic										
9	Chad										
10	Comoros										
11	Congo, Democratic Republic of										
12	Congo, Republic of										
13	Cote d'Ivoire										
14	Djibouti										
15	Equatorial Guinea										
16	Eritrea										
17	Eswatini (Formerly Known as Swaziland)										
18	Ethiopia										?
19	Gabon										
20	Gambia, The										
21	Ghana										
22	Guinea										
23	Guinea-Bissau										
24	Kenya										?
25	Lesotho										
26	Liberia										
27	Madagascar		70	1							
28	Malawi										x
29	Mali		30	21							
30	Mauritania										
31	Mauritius										
32	Mozambique										
33	Namibia										
34	Niger		50	1							
35	Nigeria										
36	Rwanda										x
37	Sao Tome and Principe										
38	Senegal		50	2							
39	Sechelles										
40	Sierra Leone										
41	Somalia										
42	South Africa										x
43	South Sudan										
44	Sudan										
45	Tanzania										
46	Togo										
47	Uganda										?
48	Zambia										
49	Zimbabwe										x
Total			200	25			6			11	

Source: By authors.