Chapter 3

Risk Analysis and Mitigation Strategy Identification

Before exploring risk mitigation solutions available to public and private actors, this chapter first focuses on the identification and definition of investment risks associated with clean energy access solutions in sub-Saharan Africa. It provides the reader with a comprehensive understanding of the hurdles linked to clean energy access financing across the region.

It starts by presenting the different investment opportunities considered in this book, namely stand-alone solar systems, mini-grids, power generation plants, national grids and clean cooking systems. Moreover, it identifies core stakeholders, both public and private, that may significantly influence risk perception of potential funders. On top of that, a particular emphasis is put on capital providers, with the aim of presenting their key features, including the types of financial instruments and schemes usually used. It has the objective to provide the reader with a comprehensive overview of investors potentially active in the region for investments related to clean energy access.

The second part of the present chapter focuses on the definition of the investment risks, encompassing economic and financial factors, the overall country situation, the business environment, and social and environmental considerations. Furthermore, these investment barriers are linked to each investment opportunity. Finally, risk mitigation strategies are identified as well as associated with the targeted risks, in order to provide a common basis before describing each de-risking solutions in the following chapters.

Risks act as barriers to investments as they increase the probability of occurrence of a negative event, affecting business activities and financial returns. It is therefore important to release a comprehensive mapping of investment risks as well as understand their root causes. This involves three core tasks:

- i. Description of investment opportunities able to promote clean energy access in sub-Saharan Africa
- ii. Identification of core stakeholders directly and indirectly involved in the clean energy sector
- iii. Identification of investment risks behind the selected investment opportunities

3.1 Investment Opportunities in the Clean Energy Sector

Energy access can be addressed by different production means (e.g. stand-alone systems, mini-grids, extension of the grid, etc.) depending on site-specific elements like the expected demand, the resource base, the comparative costs of different equipment and the distance to the grid. Site-specific least-cost electrification solutions can be modelled (Hafner et al., 2019).

This subsection provides a definition of every solution chosen for the scope of this book, having the potential to enhance the access to clean energy in both urban and rural areas across sub-Saharan Africa. This will allow an understanding of the risks associated as well as the drivers behind those investment opportunities. The risks are presented in detail in the following subsection.

3.1.1 *Stand-Alone Systems*

Stand-alone systems are designed for persons living beyond the reach of the grid or with unreliable power supply. These solutions enable different domestic and productive energy uses (Tier 1 and above¹), from lighting and phone charging to the provision of power for household appliances and micro-, small- and medium-scale businesses (i.e. refrigeration, irrigation, agro-processing). Stand-alone solutions can operate with or without storage capacity and may possibly combine solar power with another energy resource (hybrid solutions).

During the last two decades, many aspects of this sector have undergone profound changes and business models have deeply evolved. Innovations continue to this day, enabling products and services to be customised to energy consumption and financial affordability of targeted customers (GOGLA, 2020). Energy solutions are now proposed in various formats, ranging from service-based, pay-as-you-go (PAYGO) and leasing models to the sales of devices through single or multiple payments. In addition, mobile money and consumer finance becoming incrementally more available have been instrumental in supporting sales growth (Persistent Energy Capital et al., n.d.).

Nowadays, the sector is mainly vertically integrated even though specialisation has started to emerge. Companies are operating in a highly dynamic and increasingly

¹For a complete definition of Tiers, please refer to Annex 1.

competitive market. Some of them are beginning to diversify their product range, pairing the provision of energy devices with the selling of other products.

Stand-alone systems can be installed rapidly, and their payback periods are relatively short. In addition, they represent a cost-effective option in many situations thanks to an increasing reliability and decreasing costs of technologies (IRENA, 2015). The sector is usually lowly correlated with the global economy and less dependent to specific regulations like tariff setting and permitting. Consequently, they are seen as a powerful solution in the quest for universal access to clean energy.

The addressable market is potentially huge, encompassing rural and peri-urban zones, without grid connection or with low reliability of supply. Some companies have reached a significant size and are now serving an important number of households, located in different geographical areas, with distinct demographic and socioeconomic profiles, thus enabling customer portfolio diversification.

Over the last decade, unit economics have improved significantly in the sector. However, most of the companies active in the sub-Saharan region have not achieved profitability yet. The main reasons are the elevated costs related to hardware development as well as expensive and possibly complex last-mile distribution. In addition, stand-alone systems are capital-intensive businesses since they usually hold substantial inventories and client receivables. And the working capital needs increase with the customer portfolio.

To date, investments have been largely concentrated in few companies and in countries presenting stable macroeconomic situations (Acumen, 2018). By 2030, stand-alone systems might represent the least-cost electrification option for nearly 25% of the continent population (IEA, 2019).

3.1.2 *Mini-Grids*

Mini-grids are schemes consisting of small-scale decentralised systems providing power into a network which supplies a limited number of customers. Most of the time, they are employed in relatively remote zones, as they can operate in isolation from national grids. The energy resources considered here are solar PV, wind or hydro, as well as hybrid solutions.

By offering a significant and stable source of power (Tier 1–5²), mini-grids have the potential to support local economic development, enabling access to electricity for households, micro- to medium-scale enterprises as well as anchor consumers (e.g. health centres, telecom towers, schools).

Unlike stand-alone systems, mini-grids are not retail businesses and rather act as small-scale utilities. They have characteristics close to an infrastructure investment and high sensitivity to financing costs. Moreover, they face significant upfront costs as well as specific regulations regarding licensing, permitting and in some cases tariff setting. However, the construction period is shorter than medium- and large-scale

²For a complete definition of Tiers, please refer to Annex 1.

power generation plants, as project developers try to adapt the installed capacity to the community served.

The ownership and operational structures of mini-grids can vary significantly. This is an important aspect since it may strongly impact the management and operations, as well as the risks associated with this investment opportunity. The owners and operators can be either a private, public or community-based entity.

As stand-alone systems, mini-grids have witnessed a decrease in costs of technologies and an improved reliability. They also target rural and peri-urban areas and consequently operate in an important addressable market. However, they require concentrated settlements to power a certain number of customers in order to become financially viable. In addition, when managing a single mini-grid, economies of scale and diversification opportunities are low. Nevertheless, project developers generally operate a portfolio of mini-grids, allowing to serve heterogeneous communities.

In some countries across Africa, governmental entities are considering mini-grids as a crucial part of their energy roadmap and are increasingly favouring their development. According to the International Energy Agency, mini-grids will provide access to electricity to over 30% of the continent's inhabitants by 2030 (IEA, 2019).

3.1.3 Medium- and Large-Scale Power Generation Plants

Concerning power supplied in centralised systems or for significant electricity needs, this book considers generation plants with an installed capacity of 50 MW and above, that are usually but not necessarily connected to the national grid. The book focuses on decarbonised and low-carbon energy resources, including solar PV, wind, hydro and natural gas. Similar to other regions around the globe, power demand is growing in Africa, leading governments to increase the supply in their territories. Combining this with environmental considerations and the energy access challenge, renewable and low-carbon resources are regarded as interesting options for power generation in the region.

Like the two investment opportunities presented previously, power generation plants benefit from an increasing reliability as well as decreasing costs of technologies (Boston University et al., 2020). In addition, they are characterised by capital intensity,³ the need for long-term financing due to long payback periods and a high sensitivity to financing costs (Waissbein et al., 2013).

Over the last years, the African continent has started to witness vertical disintegration and the privatization of power generation in several countries. One of the objectives behind those initiatives was to encourage the presence of private players and the involvement of strategic actors, in order to improve efficiency within the sector and crowd in private capital (REW, 2019). Accordingly, many medium- and

³Renewables energy resources have a higher capital intensity (high investment costs and low operational ones) than natural gas.

large-scale power generation plants across the continent are built and managed in the form of independent power producers (IPPs).

Several innovative financial mechanisms and tariff schemes aimed at reinforcing the competitiveness and attractiveness of renewable energy resources for power generation have been introduced during the last decades. Those opportunities as well as their availability and implementation in sub-Saharan Africa are analysed further in this book.

3.1.4 National Grid

National grids transmit and distribute the power generated in dedicated plants. For the scope of this document, two different types of investment opportunities are considered: (i) upgrade and reliability improvement, (ii) grid expansion. They are grouped under the same category as they present some similar risk features.

Vertical disintegration of the power sector has emerged in several African countries (Attia, 2019). However, apart from few exceptions, distribution and transmission infrastructures have traditionally been publicly owned and operated (Pudney, 2018). Less than 20% of sub-Saharan countries allow the participation of private actors in this part of the power supply chain (Res4Africa, 2020). Accordingly, short political cycles may challenge public commitment to long-term transmission and distribution projects.

Investment sizes are relatively less substantial compared to power generation plants. Nevertheless, frequent financial difficulties faced by many African electricity utilities as well as low financial returns commonly associated with transmission and distribution prevent the realisation of the required investments for maintenance, upgrade and expansion. Consequently, energy infrastructures in the region are usually ageing, facing reliability issues and significant line loss rates, thus partly explaining the relatively high electricity tariffs charged in several sub-Saharan countries (Attia and Shirley, 2018). Moreover, electricity grids are generally not adapted to the integration of renewable energy resources and frequently deprived of technical innovations of a modern power system, supporting supply and demand management (i.e. smart grid technologies).

In addition, several locations in the region are not connected to national networks yet, whereas projects dedicated to grid expansion can be complementary to decentralised solutions and enhance access to electricity in many areas. However, grid extension is often technically complex. Furthermore, few African power utilities are tasked with a universal service mandate. This combined with cost-recovery issues and poorly maintained assets leave millions of potential customers unconnected, including 110 million living beneath existing grid infrastructure in sub-Saharan Africa alone (ibid.).

In order to provide universal and high-quality service to end-consumers as well as meet existing and future power demand, substantial investments are urgently needed to close the power infrastructure gap across the region. Grid extension and

densification will be, according to the International Energy Agency, the most effective solutions for nearly 45% of the population gaining access to reliable electricity supply by 2030 (IEA, [2019](#)).

3.1.5 Clean Cooking Systems

This book considers four different options for clean cooking: (i) electrical cooking systems, (ii) LPG tanks, (iii) improved cookstoves for biomass combustion and (iv) biogas digesters. The first listed solution is strongly linked to electrification. The last three may entail not only the selling of cookstoves, but also the production and distribution of their respective fuels, which adds complexity for business models proposing those devices. Biomass combustion is widely used in Africa, sometimes causing forest degradation and health issues. Here, the book focuses on improved solutions avoiding indoor pollution and consuming biomass coming from sustainable harvesting of fuelwood. Cooking solutions using piped natural gas are not considered in the present book because of lack of pipelines across the continent. Moreover, the construction of a gas pipeline network in a near future is unlikely due to the necessity to cover long distances and—most importantly—the weak financial viability owing to low energy demand levels associated with cooking.

Just like for stand-alone systems, clean cooking companies are retail businesses selling assets with relatively short installation time and payback periods. The four clean cooking solutions presented above are grouped into a single category since broadly speaking they present similar risk features, apart from the above-mentioned complexities linked to fuel supply and distribution. At the same time, those business models can capture deeper commercial opportunities provided by recurring revenue streams associated with fuel selling activities.

Over the last decades, the sector has been constantly innovating and adapting to customers' needs, gaining increasing attention especially in East Africa. However, clean cooking is often seen as a second level priority in many emerging and developing markets despite its huge social and environmental benefits (Bhalla, [2019](#)). Accordingly, the level of funding dedicated to this sector is still relatively low, mainly due to a lack of supporting policies targeting the industry compared to other development sectors.

Even though the addressable market is significant, massive deployment is also constrained by a lack of awareness concerning health and environmental issues linked to cooking in many African countries. The difficulty to change customers' behaviour makes clean devices often seen as an unnecessary expense among communities, preferring to rely on traditional systems and using energy resources that are sometimes available for free (i.e. fuelwood).

To date, clean cooking companies have faced challenges in setting affordable pricing while presenting attractive risk-return profiles to investors. Nevertheless, financially viable enterprises are starting to emerge and raise the interest of the public and private spheres (Clean Cooking Alliance, [2019](#)). In addition, clean cooking

companies benefit from the increasing availability of mobile money and consumer finance across the continent.

Like for stand-alone systems, investments in clean cooking companies are skewed towards a selected few enterprises having reached a significant size and active in countries presenting a stable macroeconomic situation (Acumen, 2018).

3.2 Identification of Core Stakeholders

The identification of relevant stakeholders, directly and indirectly involved in the financing of clean energy access in sub-Saharan Africa, is a necessary step to properly analyse the barriers related to each investment opportunity considered in this book. This mapping helps determine groups of entities whose behaviour, through action or inaction, can potentially influence investors' risk perception, thereby affecting capital allocation and the cost of financing. Therefore, it is crucial to define their role in order to describe strategic investment pathways towards universal clean energy access in the region, without leaving certain hurdles unaddressed.

It is also important to connect each barrier to investment with groups of stakeholders able to mitigate or overcome it, thus reinforcing the understanding of the overall investment environment. Equally important, it avoids an overlapping of risk categories and increases the likelihood of developing and implementing successful de-risking strategies and risk mitigation actions.

Table 3.1 presents the groups of stakeholders considered in this book.

3.2.1 Capital Providers

This subsection provides a mapping and description of the capital providers, domestic and international, considered in this book. It aims at presenting what are the sources of funding available, the financial instruments and mechanisms commonly used as well as some key characteristics. There are categorised as follows: domestic public sources, domestic private sources, international public sources, international private sources.

3.2.1.1 The Role of Financing

As reported previously, additional investments are urgently required to ensure universal access to clean energy in sub-Saharan Africa. Potential sources of capital come from heterogenous actors with different utility functions. They include development and climate finance, concessional and patient capital, grants and commercially oriented financing. Each capital provider has its own risk appetite as well as specific focuses on different sectors and development stages. Accordingly, it is necessary

Table 3.1 Core stakeholders

Stakeholder group	Description
Public authorities	Public bodies, local and national, that establish country's objectives, policies and regulations, as well as energy targets. This category encompasses policymakers, public administrators, regulators, legislators and ministers
Power utility companies and grid operators	Organisations, usually state-owned companies, responsible for the transmission and distribution of electricity as well as in charge of grid operation. Power utilities are also electricity purchaser and off-taker from the perspective of power generators
Public development and financial institutions, multilateral agencies	National, bi- and multilateral institutions created by a single state or a group of countries, providing professional services, including financial ones, aimed at addressing social and environmental challenges
Project developers and operators	Entrepreneurs and persons involved in the development and management of clean energy-related projects, investing time (and usually money) as well as bringing specific skills and expertise
Investors and capital providers	Domestic and international capital providers, individuals or institutions, using different financial instruments and schemes, ranging from traditional to alternative ones. For more details, see the next subsection dedicated to this group of stakeholders
Supply chain and business partners	Players, including intermediaries, active in the supply chain of the power and clean cooking sectors (upstream and downstream), as well as other actors involved directly or indirectly in energy access (i.e. microfinance institutions)
End-consumers, end-users	Customers and communities using energy services and products
Civil society	General public and non-governmental organisations (NGOs) representing the voice of the civil society

Source Authors' elaboration, based on IRENA et al. (2018), UNDP and ETH Zurich (2018), Weissbein et al. (2013)

to align financing needs, risk-reward profiles and risk tolerance levels in order to catalyse the required redirection of finance and effectively mobilise or blend those sources of capital.

Investments in clean energy access span multiple asset classes, ranging from equity and fixed income to real estate and commodities (Donovan, 2015). Consequently, the clean energy sector is not an asset class by itself, but rather a sub-category within a variety of distinct asset classes, helping positioning it within the universe of investment opportunities available to different capital providers. Therefore, the sector has the potential to attract various investors, coming from the public and private spheres.

As previously reported, public funds alone will not be sufficient to bridge the funding gap related to clean energy access in the sub-Saharan region. However, the public sector has a key role to play in creating of an enabling investment climate and attracting private capital. Policymakers and public financial institutions should make an effective use of their limited resources, directing them where most needed and addressing specific constraints faced by private actors.

Similarly, the private sector is also crucial. Apart from capital, it may bring innovative financing schemes and mechanisms. Moreover, private players can add new and valuable skills to the table and create competitive frameworks. Therefore, the public and private spheres are both necessary and must complement each other in order to maximise efficiency in tackling the clean energy access challenge across sub-Saharan Africa.

3.2.1.2 Public Actors

Public actors have traditionally focused on direct investments, using mainly equity financing, lending (concessional or not) and grants, targeting public and private entities. However, recent years have seen an increasing emphasis on the use of mobilisation tools (i.e. public-backed investments, liquidity facilities, derivatives instruments), as well as on the funding of specific programs and policies aimed at crowding in private capital (IRENA, 2016).

Table 3.2 presents public capital providers considered in this book along with some key features.

3.2.1.3 Private Actors

Over the years, the private sector has accumulated significant experience in using different types of financial instruments, structures and mechanisms, providing constant innovation and adapting to specific needs of various industries, including the energy sector.

Table 3.3 presents private capital providers considered in this book along with some key features.

Table 3.2 Public capital providers

Description	Main features	Location	Financial instruments and schemes ^a	Examples
National government agencies	Public financial resources coming from tax revenues, national budgets, public financial institutions, sovereign wealth funds and public pension funds	Domestic	Grant Debt Green bonds Equity Specialised investment vehicles Blended finance Guarantees and insurance Subsidies	National Development Bank of Zimbabwe, Agaciro Development Fund (Rwanda), Bayelsa Development and Investment Corporation (Nigeria), Equatorial Guinea Fund for Future Generation, Bank Windhoek Retirement Fund (Namibia), Caisse Nationale de Prévoyance Sociale (Côte d'Ivoire), Libyan Investment Authority, Algeria Revenue Regulation Fund, Government Employees Pension Fund (South Africa)
International financial institutions, development finance institutions (DFIs) and multilateral agencies	Regional, bi- or multilateral agencies, using raised capital or acting on behalf of donors	International	Grant Debt A/B syndicated loans Equity Specialised investment vehicles Blended finance Credit lines Guarantees and insurance Liquidity facilities Derivative instruments	African Development Bank (AfDB), Development Bank of Southern Africa (DBSA), Islamic Development Bank (IsDB), New Development Bank (NDB), World Bank, European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB)

(continued)

Table 3.2 (continued)

Description	Main features	Location	Financial instruments and schemes ^a	Examples
Public financial agencies and national development institutions	Sovereign wealth funds and national development agencies	International	Grant Debt A/B syndicated loans Blended finance Liquidity facilities	Department for International Development (DFID), China Investment Corp., China Exim Bank (CHEXIM), Gesellschaft für Internationale Zusammenarbeit (GIZ), Agence Française de Développement (AFD), Norway Government Pension Funds
Climate finance institutions	International climate funds and intermediary institutions aimed at channelling public funds to climate-related projects	International	Grant Debt Equity Blended finance Guarantees Credit lines Derivative instruments	Global Environment Facilities (GEF), Green Climate Fund (GCF), Climate Investment Funds (CIFs)

(continued)

Table 3.2 (continued)

Description	Main features	Location	Financial instruments and schemes ^a	Examples
Public export credit agencies	Public organisations supporting corporations doing business in developing and emerging markets	Domestic/international	Debt Guarantee instruments (mainly targeting political and commercial risks)	Nigerian Export–Import Bank, Export Credit Guarantee Corporation of Zimbabwe (ECGI), Multilateral Investment Guarantee Agency (MIGA), Compagnie Française d’Assurance pour le Commerce Extérieur—Coface (France), Euler Hermes Kreditversicherung (Germany), Servizi Assicurativi del Commercio Estero—SACE (Italy)

Source Authors’ elaboration, based on GCF (2013), Hafner et al. (2020), WEF (2019)
^aHere, the financial instruments and schemes commonly used are listed, without excluding possible exceptions

Table 3.3 Private capital providers

Description	Main features	Location	Financial instruments and schemes ^a	Examples
Local banks	Private commercial, investment and development banks, providing local currency financing but usually constrained by their balance sheet sizes, prudential ratios and liquidity costs	Domestic	Debt Syndicated loan Equity	Eritrean Investment and Development Bank, Ecobank Nigeria Plc, Nedbank
Private institutional investors	Large-scale and long-term-oriented investors, which pool capital to purchase securities, real estate properties or investment assets They can potentially play a major role in the financing of clean energy access, having large assets under management (AUM) In addition, they have an appetite for responsible investments due to their fiduciary duties, even though their primary objective is to ensure expenditures (pensions, annuities, insurance)	Domestic/international	Debt Syndicated loan Equity	Private insurance companies and pension funds
Foreign banks	Private and commercially oriented banks, investing not only locally but also abroad	International	Debt Syndicated loan Equity	Credit Suisse, BNP Paribas, UniCredit

(continued)

Table 3.3 (continued)

Description	Main features	Location	Financial instruments and schemes ^a	Examples
Investment funds, venture capitalists (VC), private equity investors, non-bank financial institutions (NBFI) and asset managers ^b	Collective investment schemes used to invest directly in clean energy initiatives or through financial intermediaries	Domestic/international	Debt Equity Derivatives	Investment Fund Africa (IFA), Energy Capital Partners, Simmons Energy, BlackRock
Impact investors	Investors looking for financial returns along with positive social and environmental impacts	International	Debt Equity Alternative financial instruments	Acumen, Bamboo Capital Partners, ResponsAbility Investments, Symbiotics, OikoCredit, Triodos Bank, The Ecosystem Integrity Fund
Philanthropic foundations, endowments, trusts	Non-governmental organisations and corporations, using capital provided by donors or philanthropic arms for social and environmental purposes	International	Grant Debt	Open Society Foundations, philanthropic arm of big corporations ^c
Strategic partners, enterprises and corporations	Private utilities, energy companies and big corporations investing in energy-related projects	Domestic/international	Debt Equity	ENI, Enel Green Power, Facebook, Google, Microsoft
Private export guarantee agencies	Private organisations supporting corporations doing business in developing and emerging markets	International	Debt Guarantees	Foreign Trade and Investment Promotion Scheme (AGA, Germany)

(continued)

Table 3.3 (continued)

Description	Main features	Location	Financial instruments and schemes ^a	Examples
Crowdfunding and P2P lending platforms	Clustering of a large number of investors (usually investing small amounts of capital) to finance businesses through digital platforms that bring the supply and demand of capital together	Domestic/international	Grant Debt Equity	Energise Africa, M-Change, Crowd Power
Angel investors	Individuals investing at the earliest development stages of a business	Domestic/international	Equity Alternative financial instruments	-
Project developers/entrepreneurs	Persons and private entities starting and managing a project or a business in the clean energy sector	Domestic/international	Equity Shareholder loans	Somedix, African Clean Energy, Jumeme

Source Authors' elaboration, based on AfDB (2013), IRENA (2016), UN (2019)

^aHere, the financial instruments and schemes commonly used are listed, without excluding possible exceptions

^bThis category also encompasses family offices and high-net-worth individuals

^cAs an example, *Energias de Portugal* provided grants for mini-grid deployment in Mozambique

3.3 Identification of Investment Risks

3.3.1 *Investment Risks*

From a capital provider perspective, investments risks are often defined as the occurrence probability of an event implying negative consequences on expected financial returns. They are caused by uncertainties, human behaviour and/or unpredictable events related to complex situations.

Investment risks and expected returns are strongly linked. Indeed, investors adjust their requested financial returns considering the risks taken. Accordingly, the perceived risks in an investment environment should be reflected in the cost of financing. In addition, if the risks perceived are considered as too elevated in a given situation, some capital providers can even decide not to invest, thus reducing the supply of capital in a specific market or for a particular sector.

Certain risks are directly associated with the technical characteristics and financial structures of the selected investment opportunities. Others echo broader concerns in particular macroeconomic contexts and may vary greatly from one place to another. Generally speaking, developing and emerging countries tend to have higher financing costs, reflecting a number of actual and perceived risks (UNDP and ETH Zurich, 2018). As many clean energy initiatives are highly sensitive to the cost of financing, the later can thus negatively affect their financial viability.

3.3.2 *Risk Management as a Dynamic and Context-Dependent Process*

Nowadays, socioeconomic status, geopolitical balances and political situations are constantly and rapidly evolving. For this reason, a risk management framework cannot be static. Conditions change overtime, bringing out new risks and affecting the identified ones, thus constraining regular iterations and ongoing monitoring.

In order to attract private investments at scale and decrease the cost of financing, a thorough understanding of all the risks involved is required to properly address them and create interesting risk-return profiles adapted to the heterogeneity of capital providers. To do so, the first step consists of building a comprehensive list of risks for each selected investment opportunity, providing an overview of the risk environment (**risk identification**). Equally important is the assessment of the identified risks, particularly their probability of occurrence and loss potential (**risk evaluation**). The mapping of all involved risks, their description and a grasp of their different levels of importance will ease the elaboration of de-risking strategies and risk mitigation actions (**risk treatment**) (Alliance for Rural Electrification et al., 2015). This last step also includes an effectiveness assessment of those initiatives through cost–benefit analysis.

The present book focuses on identifying risks associated with clean energy initiatives as well as presenting strategies emanating from public and private players to mitigate them. Risk evaluation and the selection of an adequate set of tools to address specific investment barriers should be context-dependent and reflect specific socio-economic and cultural factors. Therefore, those last two steps of the risk management process are outside the scope of this book.

3.3.3 Risk Definition

This book classifies the investment risks into the following four areas: (i) economic and financial factors, (ii) overall country situation, (iii) business environment and (iv) environmental and social considerations.

This subsection aims at defining every risk category to facilitate their allocation to investment opportunities, link them with relevant groups of stakeholders and identify adequate de-risking and risk mitigation strategies.

3.3.3.1 Economic and Financial Factors

a. Currency risk

Also referred to as the exchange rate risk, the currency risk arises from unpredictable change in the value of one currency relative to another, thus affecting assets, liabilities and cash-flows over time.

More specifically for the sub-Saharan African energy sector, investors are exposed to the currency risk when investing in hard currencies⁴ (thus requiring associated payments in those legal tenders), whereas investees generate revenues and carry out commercial transactions in local currencies.

In addition, some countries have poor currency convertibility, meaning the swap of the domestic currency for another can be limited. A difficult economic and political situation within a country may lead to low currency convertibility and thus create an additional risk for investors.

b. Liquidity risk

In a context of debt-like instruments, the liquidity risk refers to the inability of a borrower to fulfil its financial obligations when due, without selling less-liquid assets at a discount price. For equity investors, an illiquid market offering few or no exit opportunities inhibits the generation of part or the entirety of financial returns. The

⁴Hard currencies are issued by nations seen as politically and economically stable. They are considered as highly liquid and benefit from the confidence of international investors and businesses. Broadly speaking, they include the US dollar, the European euro, the Japanese yen, the British pound, the Swiss franc, the Canadian dollar and the Australian dollar.

liquidity risk also includes refinancing, namely the incapacity to replace a financial obligation with a new injection of capital, ideally at a lower cost.

The liquidity risk can stem from internal factors linked to the investees (i.e. cash-flow issues, low credit rating) or external ones associated with the market environment, ranging from little or no availability of capital to limited access to affordable financing options. In addition, certain investment opportunities considered here have long payback periods, high upfront costs and/or low expected financial returns. Those inherent characteristics require specific financial terms and instruments as well as adequate ticket sizes, not necessarily available in every capital market in sub-Saharan Africa.

The reduced availability of tailored and affordable financing may in part be explained by the limited experience of certain capital providers with regard to some financial structures and/or the clean energy sector. The latter has a relatively low track record as far as finance is concerned compared with the fossil fuel industry. Accordingly, many potential sources of capital lack familiarity with certain specificities of the associated investment opportunities. Moreover, several local capital markets across the African continent are currently under-developed, thus restricting market participants from accessing specific financial schemes and cheaper capital.⁵

c. Other financial and economic risks

The potential change in global interest rates is another risk that may affect financial investments, most directly the value of bonds and other fixed-income securities.

Furthermore, inflation can undermine an expected financial return through a decline in purchasing power (all other things being equal). It may create a significant gap between nominal and real returns of financial investments.

Those two risks as well as the currency risk are not directly linked to the clean energy sector, but rather to macroeconomic considerations.

3.3.3.2 Overall Country Situation

a. Political, legal and regulatory risk

Also known as the country risk, this category is broad and encompasses instability arising from changes in governing bodies, legislative resolutions within a country or a region, as well as lack of public commitment. Political volatility can potentially alter expected outcomes, annihilate financial investments or even remove the possibility to withdraw capital from a financial operation. Furthermore, government interferences, bureaucratic hurdles and administrative delays are important features that may impede the implementation of a project and increase the associated costs. Considering the extensiveness and potential impact of this risk category, mitigation without external support is usually complicated.

⁵See Chap. 6 dealing with capital market development for more detail.

Businesses, industries and the overall economy can be strongly disrupted by uncertainties concerning political decisions and legal frameworks, in particular changes in regulations, fiscal regimes, labour laws and public spending. Some private actors may even witness asset expropriation, leading to the impossibility to conduct operations. In addition, geopolitical considerations, together with political turmoil, conflicts and international disputes might impact the envisaged transactions and the expected outcomes.

Equally important, problems of corruption can hinder the uptake of clean energy solutions and the entrance of private market participants. It may for instance affect public commitment, procurement processes and project assignation. Moreover, market distortion created by public policies (i.e. fossil fuel subsidies) impacts the competitiveness of clean energy solutions. Similarly, complex procedures and time-consuming processes raise transaction costs and may hamper the development of the sector.

Certain investment opportunities in the clean energy sector are deeply concerned by the country risk. For example, the development and operations of power generation plants and mini-grids strongly depend on specific political decisions such as tariff setting, licensing, permitting, land concessions and grid access. Likewise, grid arrival represents an important risk for the mini-grid sector and is considered as a political one since grid expansion is usually part of electrification roadmaps defined by public authorities.

Finally, the overall context can affect financial investments aimed at fostering the access to clean energy in sub-Saharan Africa. Indeed, the state of infrastructures represents a major challenge for power generation plants, since the deployment of renewable energies induce an upgrade or expansion of the national grid to manage intermittency and ensure connection with the transmission lines. Likewise, other factors, like mobile money penetration, need to be supported by public authorities in order to achieve their initial objectives as well as support the use of clean energy products and services.

b. Lack of investment-ready projects

As previously mentioned, there is no capital shortage at a global level. However, capital providers may face challenges in finding high-quality projects that are ready to be financed. This may happen for projects or companies at different development stages.

It is mainly attributed to a lack of common understanding between project developers and capital providers. This gap may come from different factors such as lack of capabilities to develop and present a bankable project, inappropriate risk allocation, as well as weak feasibility studies and business plans (McKinsey, 2020). Accordingly, it hinders financial closure, letting financing needs unmet and available capital not directed towards the clean energy sector.

3.3.3.3 Business Environment

a. Customer risk

In this present context, customer risk is related to unpredictable consumption, low energy demand as well as non-payments by end-users.

In developing and emerging economies, lack of information is frequent regarding socioeconomic situations and energy demand. Therefore, it adds uncertainty and blurs the assessment of the addressable market. Particularly in the power sector, a lower than expected electricity consumption can endanger the economic situation of a company.

In addition, the demand of energy may be particularly low in certain areas of the African continent, especially in rural zones where markets are small and dispersed, making financial viability difficult to reach and reducing commercial appeal of investment opportunities.

Finally, non-payments by customers can occur in two distinct situations. First because of financial constraints, as some consumers do not own and earn the necessary financial resources to cover energy-related costs. Second, unwillingness to pay due to a lack of satisfaction regarding a product or a service may also lead to non-payment, thus negatively affecting the financial viability of a project or a company.

b. Operational risk

It refers to internal procedures, workforce and systems, as opposed to systemic risks that concern an entire industry, country or region. Operational risk focuses on the manner things are executed and managed within a specific organisation. This risk category may be caused by a lack of skilled personnel, technical issues or fraud, which leads to system and operation failure. Likewise, an improper management of external stakeholders can strongly affect the conduct of a business and its functioning.

The clean energy sector presents particular features that increase the operational risk. For instance, power generation plants face specific risks associated with system interconnection. Similarly, the decommissioning of power generation plants as well as the management of energy assets when they reach the end-of-their life cycle are important factors to consider for project developers and investors. Finally, the operational risk also comprises the complexity of specific activities linked to the off-grid and cleans cooking sectors such as distribution and after-sales services.⁶

c. Counterparty risk

It refers to the likelihood that a business partner or a component of the value chain defaults on its obligation. For instance, limited financial capacities of power off-takers add significant risk for investors and may prevent the ability to secure adequate

⁶For stand-alone systems, limited product range is also considered as a risk. Indeed, certain enterprises have started to pair the selling of power devices with other products to mitigate this risk.

guarantees and collaterals for project developers. It is often cited as the most pressing deterrent to power generation plants financing (Boston University et al., 2020).

This risk category is also linked to technical malfunctions, defects or failures of a system, thus posing a risk that assets do not perform according to expectations. Furthermore, delays during the precompletion phase (construction and development risk associated with greenfield projects) or while operations are ongoing can be caused by business partners and may thus entail cost overruns.

Moreover, the absence of clear and detailed information coming for a third party may affect investment decisions. Unreliable data related to specific markets, grid infrastructures or energy demand may engender the development of an inadequate business model. Furthermore, a rushed feasibility study may cause lower revenues than expected⁷ when solar, hydro and wind energies are used.

In addition, certain investment opportunities considered here may face important issues linked to fuel supply⁸ when biomass or natural gas are used as energy resources. Two distinct situations can arise: lack of resource availability implying the impossibility to use energy devices; an unexpected increase in prices resulting in higher operational or utilisation costs.

d. Competitive risk

It corresponds to a decrease of market shares due to competitive forces, leading to a decline in revenues. In addition, an energy device may become obsolete because of technological evolution, affecting its competitiveness.

Apart for direct competitors active in the same industry and with an equivalent geographical focus, any available alternatives directly compete with a product or a service as well. For instance, the abundance of coal in certain regions and its historical legacy may make the move to cleaner energy resources long and complex.

3.3.3.4 Environmental and Social Considerations

a. Climate risk

Climate conditions are a risk caused by external environmental influences, which may affect the development and operations of activities in the clean energy sector. Indeed, an environmental disaster can be devastating. Similarly, climate change may strongly impact the general performance of a project.

For example, a crippling drought strongly decreases the performance or even stops the operations of a hydro power plant. Energy scarcity is equally valid for devices using biomass as energy resource. Likewise, floods could make roads impassable, preventing distribution and maintenance activities. Moreover, weather events, like cloud coverage, alter the outcome of a solar energy system.

⁷For instance, an over-estimation of solar radiation will cause lower revenues than expected.

⁸It can also be seen as an operational risk in the case a company is vertically integrated and manages its own fuel supply.

Energy infrastructures are also exposed to the impacts of climate change, potentially causing system breakdowns, supply disruptions and power losses. Finally, pollution coming from the use of natural gas is also included in this category.

b. Social acceptance risk

Potential social barriers to the implementation of clean energy solutions can be very challenging to overcome and must be properly thought out in advance. The ability to ensure that a project is well embedded in a specific sociocultural context is crucial in order to avoid a certain number of issues. Otherwise, the probability of project delay or even failure is high.

In the energy sector, a first obstacle is public unacceptance. The latter can stem from a misperception of the long-term effectiveness of clean energy solutions when compared to traditional ones already in place. Moreover, low awareness of potential co-benefits in the use of clean energy products and services can lead to strong opposition movements and a limited interest of the private and public sectors. Similarly, the not-in-my-backyard (NIMBY) syndrome, based on the potential economic, social and/or environmental impacts a project can provoke, may cause delays and even the cancellation of a project proposal, thereby incurring additional costs.

Additionally, some groups have vested interests in maintaining the status quo. As a matter of fact, players and countries involved in the fossil fuel industry might have little incentives to promote clean energy solutions. Certain sectors, such as coal in South Africa, might fear job losses. Therefore, actors active in this industry may oppose the deployment of cleaner energy solutions, seen as a direct threat for their business activities and employment situations.

Finally, certain energy resources like hydropower and biomass are not exclusively used for energy purposes. Their exploitation can therefore enter in competition with other utilisations and generate conflicts between involved parties.

The above-described situations can have a strong impact on the deployment of certain businesses and affect the security of sites of operation. They may lead to vandalism, physical damages as well as theft of valuable material and system components. Furthermore, when a local community does not accept the implementation of a project, illegal connections⁹ are more frequent.

Table 3.4 sums up the different risks previously explained.

3.3.4 *Risks Associated with Investment Opportunities*

Depending on the contexts and business models considered, certain investment risks identified in Sect. 3.3 might not be relevant. However, the intention of this book is to encompass several barriers present in sub-Saharan Africa in order to propose pertinent de-risking actions and risk mitigation mechanisms.

⁹Illegal connections may also be linked to other factors such as financial affordability.

Table 3.4 Investment risks

Risk group	Risk category	Sub-category
Economic and financial	Currency risk	Exchange rate
		Currency convertibility
	Liquidity risk	Default/bankruptcy
		Access to affordable capital
		Refinancing risk
		Lack of exit strategies
	Inflation	–
	Interest rate	–
Overall country situation	Political, legal and regulatory risk	Policies and regulations
		Political turmoil and instability
		Bad governance, corruption, lack of political commitment
		Bureaucratic hurdles
		Market distortion
		State of the infrastructures
		International disputes
		Grid arrival and access
	Lack of investment-ready projects	–
Business environment	Customer risk	Lack of information
		Low demand
		Affordability/viability gap
		Willingness to pay
	Operational risk	Internal operations
		Workforce
		Stakeholder management
		Complex business model
		System interconnection
		Decommissioning
		End-of-life cycle management
	Counterparty risk	Breach of contract
		Unreliable data
		Delays and bad performance, technological risk
	Competitive risk	Direct competition
		Alternatives
		Technological evolution

(continued)

Table 3.4 (continued)

Risk group	Risk category	Sub-category
Social and environmental considerations	Climate risk	Climate conditions
		Resource scarcity
		Pollution (natural gas)
	Social acceptance risk	Social opposition and vested interest
		Lack of awareness
		Resource competition
		Vandalism and resistance
		Illegal connections

Source Authors’ elaboration

Annex 3 presents each investment opportunity considered in this document, together with their associated investment risks as well as corresponding stakeholders that may influence each risk category.¹⁰

Many investment risks are common to all clean energy solutions and business models explored in this book. However, some differences exist. For instance, the grid arrival is considered for mini-grids but not for solar home systems or clean cooking. Likewise, system interconnection is related to power generation plants and national grids.

3.4 De-risking Strategies and Risk Mitigation Actions

After a comprehensive mapping of the investment barriers, the identification of core stakeholders able to influence each risk category and the description of potential sources of capital, this section presents risk mitigation strategies emanating from public and private actors. They focus on both country-level and project-related concerns, and have the objective to address the identified investment hurdles, ensure enabling business climates and/or reinforce the competitiveness of clean energy initiatives.

As reported earlier, investment risks are strongly linked with the availability of capital and the cost of financing. In order to increase the funding flows towards clean energy activities, risk-reward profiles need to be more attractive for capital providers. Two different but not mutually exclusive solutions are conceivable: (i) decrease the perceived risks and/or (ii) increase the potential financial returns. If feasible, the combination of both is even better to create commercially enticing investment opportunities.

¹⁰Further explanations about actions aimed at decreasing investment risks are given in the following sections.

Additionally, this section presents specific strategies aimed at aligning the supply and demand of capital. As a matter of fact, some clean energy-related projects present specific features that do not necessarily fit with traditional approaches of financing. Therefore, some mechanisms need to be developed and implemented to match the needs of all stakeholders.

While a wide range of risk mitigation and de-risking strategies are available, the selection of an effective and efficient mix of tools is very challenging and would differ from one country to another and from one project to another. As previously mentioned, it should reflect socioeconomic profiles, cultural factors, energy demand levels, current access status and national endowments. In addition, institutional, technical and human abilities, as well as resource availability need to be considered.

As this section does not focus on a specific geographical area, it presents public and private schemes and mechanisms without assessing their cost-effectiveness and efficiency in concrete situations.

3.4.1 Four Different Spheres of Interest

This book considers de-risking strategies and risk mitigation actions in four distinct areas:

- A. **Public policies and initiatives:** they focus on specific risks and aspire to mitigate or remove the root causes of the targeted barriers. The latter are not only linked to the deployment of clean energy solutions, but also to particular concerns faced by capital providers at a country level.
- B. **Public financial and fiscal mechanisms:** this category encompasses the transfer of risks from the private to the public sector as well as direct financial incentives to compensate for residual investment barriers, without attempting to address a specific hurdle.
- C. **Private financial structures and mechanisms:** in this area, the emphasis is placed on private financial schemes aimed at fostering the allocation of capital in the clean energy sector.
- D. **Private initiatives:** they include specific actions undertaken by project developers and managers to reduce risk perception of potential capital providers. They usually target specific risks associated with their business models.

Figure 3.1 shows a visual representation of the classification of risk mitigation and de-risking actions.

3.4.2 Risk Mitigation Strategy Identification

The following table summarises risk mitigations actions within their respective categories. In addition, Annex 4 links those schemes with the identified investment

Fig. 3.1 Risk classification. *Source* Authors’ elaboration

barriers presented in the previous section. The next chapters provide a description and deeper analysis of each instrument and scheme reported in Table 3.5.

Table 3.5 Risk mitigation strategies

Public	Policies and initiatives	Energy strategy and planning
		Governance and management practices
		Market information
		Standards of quality
		Standardisation/streamlined regulations and requirements
		Land rights and concessions
		Pipeline facilities
		Technical assistance and capacity building
		Awareness campaign
		Rural energy agencies
		Grid arrival and grid access provisions
		Utility and subsidy reforms
		Tariff setting
		International cooperation and partnerships
		Regional power pools
		Fiscal incentives
		Priority sector lending
	Financial structures and mechanisms	Direct public investments/special-purpose investment vehicles
		Alternative financial instruments and schemes ^a
		Subsidies
		Credit lines/on-lending structures

(continued)

Table 3.5 (continued)

Private	Financial structures and mechanisms	Guarantees and insurance ^b
		Hard currency PPAs
		Concessional finance and patient capital
		Alternative financial instruments and schemes ^c
		Structured finance
		Project finance
		Loan syndication
		Green bonds
		Carbon finance
		Guarantees and insurance
		Derivative and hedging instruments
	Initiatives	Internal liquidity facilities
		Flexible payment methods
		Payment default management
		Stakeholder engagement and market knowledge
		Strategic agreements, M&A and investors
		Good governance, internal procedures and staff training
		External consulting and technical assistance

Source Authors' elaboration

^aIncluding blended finance

^bIncluding currency risk guarantee funds, public external liquidity facilities, liquidity guarantees, third-party collateralisation

^cIncluding crowdfunding platforms

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