Shedding (sun)light on risks
-Perceived risks and access to finance on the off-grid solar market in Kenya

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Abstract

The market for off-grid solar solutions in Kenya has developed rapidly the recent years. The growth has required capital and access to finance, which has been mainly provided by foreign investors. This thesis examines the perceived risks on the market for off-grid solar solutions in Kenya through a series of interviews with actors engaged in the market. The purpose of the thesis is to investigate the access to capital and highlight the perceived risks that might constrain a continued positive development of the market in Kenya.

The findings of this thesis categorize the perceived risks on the market as political, economic, social, technological, legal and environmental (see full report table 2 in section 8 for subcategories). The companies engaged in the market for off-grid solar solutions should be differentiated based on their business model. This since their different value chains entails specific in risks. This study uses two modified value chains to highlight the differences in retail and distribution between the two defined market segments: product and utility. The product segment includes small-scale solar products often referred to as PICO-products and Solar-Home-Systems (SHS), which by being sold on installment now provides basic electricity to a growing number of people in Kenya. The utility segment includes minigrids with solar energy as power supply. This segment is subject to specific regulations regarding installations and operations, which is one of the main contributing factors to the difference in risks compared to the product segment. The other main factor is the way the respective segment distributes and retails their products/electricity. The distribution for the product segment is done by regular land transportation and customer interaction through sales agents, providing basic access to electricity. While the minigrids uses a local distribution grid to provide access to electricity. This leads to specific risks within the categorizes social, technological and legal risk.

This study shows that the lack of understanding of the different market segments and their context specific risks, pose a risk to the market reputation and the local actors access to finance. The absence of knowledge about the difference in risks causes generalizations to be done, both from financiers who might place their funding elsewhere, and the customers who might choose other solutions than solar to fulfill their energy needs. The uncertainty of the future development and the position of the national regulations on the market together with the two segments creates barriers for future access to finance. Access that is required to build and boost the market even further.

Keywords: Off-grid Market, Renewable Energy Finance, Perceived Risks, Solar Technology, Risk
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Uppsala, May, 2018
Agaton & Max
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1 INTRODUCTION

97% of scientists and researchers agree that climate change is human caused (Cook et al., 2016). The energy sector is responsible for at least two thirds of the greenhouse gas emissions in the world (EWO, 2016). A change in the energy sector is essential if the problem of climate change is to be solved. Reducing greenhouse gas emissions is however not the only challenge the energy sector is affecting. The United Nations (2018) refers, in their climate goal number seven, to energy as following:

“Energy is central to nearly every major challenge and opportunity the world faces today. Be it for jobs, security, climate change, food production or increasing incomes, access to energy for all is essential. Sustainable energy is opportunity – it transforms lives, economies and the planet.”

There are almost 1.1 billion households lacking electricity connections (ESAMP, 2015), of which about 600 million are located in sub-Saharan Africa (ESAMP b, 2015). The work of providing these households with access to electricity brings huge challenges for traditional means of electrification, much due to the need of consideration of climate change. At the same time, this problem brings opportunities for renewable energy sources to reshape the design of the power market (EWO, 2016). Solar energy is one of the renewable energy sources with the potential to reshape the market. In 2017 the sector for off-grid solar was estimated to provide 73 million households, worldwide, with improved access to electricity (IFC, 2018). The market is showing rapid growth and one of the most developed markets in sub-Saharan Africa is Kenya (IFC, 2018).

This rapid growth in the market indicates that the tipping point for technically feasible and economically profitable solutions using solar energy has been reached. The electrification and transformation of energy solutions in Kenya and sub-Saharan region is in motion, yet there is still a long way to go. Many businesses with new, clean and affordable solar solutions are in an initiating phase or expanding. In the phase of scaling- and growing, a business is in many cases in need of finance. The access to finance is often provided by external actors. With a growing need of investment follows an increased need to measure the associated risk and uncertainty (Burger et al., 2016).

Ioannou et al. (2017) review various studies that has been conducted on risk associated with renewable energy projects. The risks with renewable energy projects can be categorized as political, economic, social, technological, legal and environmental risk (Ioannou et al., 2017). With the hastily emerging market for off-grid solar solutions in Kenya, it is of interest to further examine the market as an area with specifically solar energy projects. Identifying potential risks posing as barriers restraining access to finance for the local entrepreneurs.
Peter Lindleim et al. (2012) describes a gap in global funding for renewable energy projects that holds back millions of projects that otherwise are ready to scale. Since the publishing of Lindleim et al., has the market for off-grid solar energy boomed in Kenya. More than 500 million USD have been raised in investments in the period of 2016-2018 alone (IFC, 2018, p1), indicating huge positive changes in the market. New conditions and evolving business entails new or changed risks. Following quote, from an interview with a local actor, serves as an example of challenges still ahead:

"We got a picture of people drying their laundry on live power cables."

1.1 PURPOSE AND SCOPE OF STUDY

The purpose of this thesis is to identify perceived risks on the market for off-grid solar solutions in Kenya. Additionally, the purpose is to examine if the big investment raised by actors on the market are satisfying the needs of the entrepreneurs on the market (i.e. whether there is a gap in funding and how that affects the market).

1.1.1 Research questions

To conduct a study of the risks with financial and operational solutions currently being used and developed in the solar energy sector in Kenya, we intend to examine following questions:

- What risks are considered in the risk assessment of local actors in the solar energy sector in Kenya, by themselves and by other actors in the market?
- Is the gap in access to finance for entrepreneurs in the market for off-grid solar solutions closed or still present?

1.1.2 Limitations

The study was delimited to the Kenyan market due to the authors possibilities to conduct interviews. The solar market was further delimited to off-grid solar systems. Off-grid solar systems are products and components that generates electric power but do not use the electrical grid for distribution. The actors mentioned and considered in this report has been businesses, financiers, energy experts and consultants active on the market.

2 THEORIES ON RISK

When investing in renewable energy projects each project has its own characteristics and challenges which makes a general framework for the matter hard to achieve. This has led to a great mixture of frameworks and concepts for risk reviews and assessments. Ioannou et al. (2017) has contributed to this problem of non-consistent risk categorization and use of methods through their comprehensive literature review on renewable energy projects (REP). Their risk categorization helps to map the risks in renewable energy investment sector. The framework uses six main categories for different sources of risk: political, economic, social,
technological, legal and environmental, which are further explained in following section. The meaning of risk and the perception of risks are then described together with a model for investment decisions. This section is concluded with an intended application of the theories presented.

2.1 **Political Risk**

Projects in renewable energy are exposed to the risk of negative influence from political instability. Factors with negative impact on REP generated from political instability are for example, lack of stable legal frameworks, bad public and corporate governance, corruption generating cost overrun and venture of profitability (Komendantova et al., 2009, p.105:108; Komendantova et al., 2011, p.4835). Political instability within the country can be triggered both from internal factors within the country, and from external factors globally or for instance in the European Union. Regardless of the triggering factor, political instability arises the risk of causing negative changes to the national economy and thereby negative impact on the profitability of the project (Jankauskas et al., 2014, p.119). It should be noted that negative changes to the national economy are not only triggered by political instability, and changes in the national economy should therefore be regarded as an own factor of risk for REP (Ioannou et al., 2017, p.606).

Changes in the public opinion arises the risk of changes in the general acceptance of renewable energy, resulting in resistance towards construction of renewable energy facilities and changes in policy support schemes. As a result of the fact that REP are active within the framework of policies, changes in policy and regulation schemes pose a risk of negatively affecting the project (Gatzert & Kosub, 2016, p.984). A part of the regulatory risks is also the risk of liabilities to third parties. Potential legal disputes with third parties regarding, environmental damage, property damage, misshaping of surroundings during construction, generating costs and potential delays (Gatzert & Kosub, 2016, p.984; The Economist, 2011, p.9). The project is also exposed to contracts risks, complex processes and complex legislation procedures can result in revenue losses (Gatzert & Kosub, 2016, p.984). Inefficient government administration and licensing procedures exposes the project to further risk of delays. Long bureaucracy processes can be resource and time-consuming resulting in the risk of unaccounted expenses for projects (Gatzert & Kosub, 2016, p.984; Komendantova et al., 2011, p.4835).

2.2 **Economic Risk**

The market for energy is not constant when regarding demand, as the market fluctuates over time. When the demand for energy declines, the price of energy drops, resulting in a lower income (Jankauskas et al., 2014, p.119). Volatility in the price of energy poses a risk of loses in revenue, the uncertainty regarding the future price of energy can result in lower income
than expected (Gatzert & Kosub, 2016, p.984; Guerrero-Liquet et al., 2016, p.4). Financing is necessary for a project to be successful, both initial investment capital and operating capital, hence REP are exposed to the risk of not obtaining enough capital (Ioannou et al., 2017, p.604). Introduction of new taxes and changes in current taxation regimes could also exposes REP to risks, risks of negative effects on revenue streams and thereby the profitability of the project (Burger et al., 2014, p.99). These revenue streams are exposed to the risk of swings in interest rates, resulting potentially higher expenses for the project (Guerrero-Liquet et al., 2016, p.4; Ioannou et al., 2017, p.604).

2.3 **Social risk**

Many of the barriers for successfully implementing a REP can be considered as a manifestation of lack of social acceptance (Wüstenhagen et al., 2007). Social acceptance can be split into three, sometimes interdependent, categories: Socio—political, community and market acceptance which are defined by Wüstenhagen et al. (2007) as follows. Socio-political acceptance is the broadest and most general social acceptance of technologies and policies, by the public, key stakeholders and policy makers. Community acceptance is about the specific acceptance of REP by local stakeholders, particularly residents and local authority. The typical pattern for local acceptance before, during and after a project follows a U-curve, from high acceptance during the planning phase, to low during the siting phase and back up when the project is up and running (Wüstenhagen et al., 2007). Distributional justice, i.e. the division of cost and benefits among the community, and the trust among the local stakeholders are important factors for the community acceptance (Wüstenhagen et al., 2007). Market acceptance is the process of the market to adapt to a technological innovation, i.e. the consumers level of understand the product as well as the communication and marketing of the product.

Acceptance can be used as a general description of valuating something positively and not rejecting it (Schweizer-Reis, 2008). The absence of acceptance can be a problem both if the reaction is negative but also since the absence can be seen as missing integration and as lack of within the technological introduction process (Schweizer-Reis, 2008). The development of acceptance amongst citizens helps them to be involved and grow with the applications, the growth ideally results in consistency, efficacy and sufficiency which changes the energy culture of production and consumption (Schweizer-Reis, 2008).

2.4 **Technological risk**

A delay regarding the projected finishing date entails the risk of additional costs. Apart from revenue losses a delay also exposes the project to the risk of not being finished on time, the project hobbling at a certain stage in the process indefinitely (Jankauskas et al., 2014, p.118)
REP are also exposed to the risk of failing to obtain all needed licenses and permits, obtaining these vital licenses/permits can sometimes be difficult if not impossible (Burger et al., 2014, p.88).

When installing and constructing new facilities for energy production the projects are exposed to risks of natural hazards affecting the construction in a negative way (Gatzert & Kosub, 2016, p.984). Some of these natural hazards can be mitigated with proper procedures by the labour constructing the facilities. However, if the constructing workers have yet to obtain the knowledge about these procedures, the identified natural hazards could still damage the facilities. Hence, unskilled labour is also a risk when constructing new renewable energy facilities (Gatzert & Kosub, 2016, p.984). It should be noted that the risk of unskilled labour is not only connected to mitigation of risks of natural hazards, it can also be viewed as a general risk for construction (Burger et al., 2014, p.100; Ioannou et al., 2017, p.604).

Using unproven components from newly developed technology can expose the project to risks with reliability. (EWEA, 2013, p.46). Many renewable energy projects are using new technologies that is yet to have been tested in large-scale and extensive way. Hence it is not certain that these projects will generate the projected amount of energy per year or require the projected amount maintenance work. Higher maintenance cost than projected or a smaller amount of energy produced then projected exposes the project to the risk of revenue losses (Burger et al., 2014, p.96). Additionally, unplanned/unscheduled plant closure exposes the REP of revenue losses, closures owing to lack of resources, plant damage and component failures (Ioannou et al., 2017, p.604; The Economist, 2011, p.9). The failure of critical components furthermore exposes REP to the risk of higher operational expenditures than projected (Ioannou et al., 2017, p.604). Taken into account when considering operation/maintenance risk must also be the potential for theft, sabotage and terrorism (Ioannou et al., 2017, p.604). For example, solar panels, transformers are of great value and are therefore potential targets for theft (Burger et al., 2014, p.100). There is also a risk with emergence of competing innovative technologies (Ioannou et al., 2017, p.605).

Some REP are exposed to the risk of shortage of wind and sun, reducing the energy production, resulting in profit decreases (Jankauskas et al., 2014, p.119) These energy sources have a factor of uncertainty, uncertainty of when they are going to produce energy and in what amount (Burger et al., 2014, p.93:94). Arising from uncertainty of commission costs are the risk of losses in revenue (Guerrero-Liquet et al., 2016, p.4).

REP connected to grids are exposed to the risk of a mismatch in demand versus supply, especially when the grids are constructed by an external party (EWEA, 2013, p.42). Connecting REP to externally constructed grids also exposes the project to risks regarding availability and curtailment, which can result in lower revenues than projected (Gatzert & Kosub, 2016, p.984; Ioannou et al., 2017, p.605). An example of curtailment is insufficient
network capacity together with overabundance in energy production, resulting in waste of energy (Gatzert & Kosub, 2016, p.990).

### 2.5 Legal Risk

New projects in renewable energy are launched in the context of the political policy landscape they are active in. A policy landscape that in some cases are beneficial for the project, active policies could for instance grant support for projects using renewable energy technology (Wiser & Pickle, 1998, p.362). If these policies where to change over time, changing the pricing policies for renewable energy and fluctuations in CO2 pricing, the profitability of the energy project could change (EWEA, 2013, p.45; Ioannou et al., 2017, p.605). REP are hence exposed to the risk of changes in policies, where short-term policies creates a high level of uncertainty (EWEA, 2013, p.45; UNEP, 2004, p.20).

### 2.6 Environmental Risk

REP are exposed to the risk of causing environmental damage (Ioannou et al., 2017, p.604). For example, when projects are investigated in the development and operation face factors with undesirable effect on the environment can be revealed resulting in additional costs (Burger et al, 2014. p.91). An example would be the discovery of an endangered species (Burger et al., 2014, p.91). Unaccounted undesirable effects on the environment can cause revenue loses as the responsibility of the effect often is put upon the project actors, hence the risk of these discovery occurring must be taken in to account (Jankauskas et al., 2014, p.119). The environmental risks might also include environmental damages and natural hazards (Ioannou et al., 2017, p.605).

### 2.7 Perceived Risk

Risk is a commonly used word, it is mostly used to acknowledge the possibility of negative outcome of a scenario. Knight (1964) defines economic risk as the event when both possible outcome of a scenario and the probability is known, where the event without known probability or outcome is defined as uncertainty. When an investor is faced with uncertainty and information asymmetries there is a possibility of losing money, so they tend to shy away. This behavior is called risk aversion and is a long-accepted term in economic theory (Arrow, 1985; Neumann & Morgenstern, 1944). There are financial instruments like insurance and other hedging contracts for investors to reduce their risk at some cost of expected return. These instruments do however fail due to information asymmetries and other barriers which leaves the investor with the risk due to uncertainties (Miranda & Glauber, 1997). This leaves the investors to make their investments decisions based on their perceived risk assessments (Komendantova et al., 2012).
Previous research in behavioral finance has introduced the idea that investors act under bounded rationality (Simon, 1955). A behavioral perspective would argue that the precepted risk and return would matter to the decision rather than an objective measure of risk and return. For decisions under uncertainty, is this perception influenced by cognitive factors which are biased depending on the investors previous experiences and available information (Tversky & Kahneman, 1974). The biased mindset can lead to decisions where gains and losses are weighted differently (Tversky & Kahneman, 1979) as well as conservatism in adjusting to new information (Tversky & Kahneman, 1974; Kahneman, 2003). This leads to a situation where the actual risks of the solar energy solutions available is rated as too risky by investors who have little previous experience and limited access to market information. Figure 1 shows a model of the relationships between the perceptions and investment decisions.

Figure 1. Model of basis for investment decisions, based on Wüstenhagen & Menichetti (2012) fig 4.

2.8 APPLICATION OF THEORETICAL FRAMEWORK

The framework based on Ioannou et al. (2017) presented in the section 2.1-2.6 above is used to categorize the risks for different actors in the market for off-grid solar solutions in Kenya. This categorization is illustrated in figure 2 below. Figure 1 illustrated above provides understanding of risk and other input to the investment decisions. This relation is used to explain the connection between specific risks and the access to finance.
3 METHOD

The study was designed to explore the perceived risks on the market for off-grid solar solutions in Nairobi Kenya. The main targets for data collection have been local actors within the market. Without pre-secured access to these actors, the methodology has been flexible and changeable during the study, to locate and gain access to the actors as the field study proceeded.

3.1 DESIGN OF STUDY

The purpose of this study is of exploratory nature where the risks considered by the respondent actor are of subjective and non-numerical type. To gain information about these
risks a qualitative study was carried. Data was collected through interviews with experts and
local actors on the market. When conducting exploratory research, it is a great advantage to be
flexible and adaptable to changes during the research (Saunders, 2007). Therefore, an
abductive approach was used to design the interview guides, using pilot interviews and
literature review as initial data collection. To fulfill the objective of the report a field study of
the off-grid solar business in Nairobi Kenya was conducted. Minimizing the physical distance
to the actors of investigation and thereby increases the accessibility and possibilities for
interviews (Saunders, 2007).

3.2 METHODS FOR DATA COLLECTION
The main source for data in the study has been semi-structured interviews with a qualitative
approach. A background study with open interviews was carried out, together with an
additional literature review. The background study was then used to design a first draft of an
interview guide and map potential interview objects. Apart from the interviews, living in
Kenya Nairobi provided additional insight to the Kenyan market for the authors. Overhearing
local citizens opinions regarding solar products and informal chats with local entrepreneurs
provided a deeper understanding of the solar market. Being in Nairobi also enabled the
authors to have a closer collaboration with the institute of nuclear science at University of
Nairobi. The institute provided initial access to local solar businesses and insights in the local
market.

3.2.1 Background study
A snowball-search for solar companies in sub-Saharan Africa showed that Nairobi Kenya,
with 24 companies, was the single most concentrated market for off-grid solar businesses.
Before meeting the off-grid solar businesses a general market review, found in section 4, was
conducted together with three open interviews.

The first interview was carried out in Uppsala Sweden with Per Kangru, one of the founders
of Solar Bora, a Swedish solar cell company active in Kenya. The interview provided a better
picture of the business climate in Kenya and how the solar cell market works in practice.

The second interview was informally with professor Michael Gatari from the institute of
nuclear science at University of Nairobi. Professor Gatari also acted as a supervisor in field.
His experience from working with the lightning global and GOGLA project to quality-certify
solar utilities gave further insights in the latest development in the market.

An interview with doctor Anthony Wambugu, director of the School of Economics at the
University of Nairobi, was also conducted. The focus of the interview was general business
climate in Kenya.
3.2.2 Gaining access

Because of the combination of the authors inexperience with the Kenyan market and the importance of the interviews, emphasises was put on gaining access to interviews. Strategies to gain access to interviews were constructed from Mark Saunders (2007) book Research Methods for Business.

New contacts where established through already established contacts. For example, the author’s supervisor in field, professor Gatari, helped established several new contacts. Additionally, during the end of every interview the respondents were asked if they had any colleagues or friends they could refer the authors to for new interviews. When establishing new contacts, the authors also clearly stated the purpose of the report to the interview objects. Highlighting the possible benefits the report could provide to the market, and displaying the potential value of participating in the research study. In the initial face of establishing contact with actors, the credibility of the research was motivated by using the Uppsala University's trademark. The anonymity of the respondents was also highlighted when establishing contact.

Because of the author’s inexperience of the market, dr. Wambugu (2018) was during the background study specifically asked about the local actors’ willingness to talk about their risks. From dr. Wambugu’s answer it could be concluded that the companies were not going to be uncomfortable answering questions on the topic of risk, based on the reoccurring business climate reports asking similar questions.

3.2.3 Interviews

Semi-structured interviews were used to obtain knowledge from actor on the off-grid solar market in Kenya. A phenomenology approach was used in the process of preparing and conducting the interviews. The aim of the phenomenology approach was to capture the perspective of the respondents in the context of the solar market in Kenya (Kvale & Brinkmann, 2012, p.42). The semi-structured design of the interviews was also used to capture the respondents’ own perceptions, the perceived risk of the actors, while maintaining the focus of the researchers’ themes (Kvale & Brinkmann, 2012, p. 43).

The answers from the respondent were meant to reflect their professional perceptions as representatives of actors in the market subject to study. The interviews were therefore preferred to be held at the offices of respective respondent. To further highlight this issue each interview was initiated with an orientation where a short background and the aim of the study were mentioned. The phenomenological approach was also followed when interviewing, acknowledging that knowledge is created in the interaction between the researcher and the respondent during the interview (Kvale & Brinkmann, 2012, p.34).

By asking the respondent to clarify their answers in the situation where a subject is described, the researchers tried to obtain a material with higher quality more useful in the transcription
and analysis (Kvale & Brinkmann, 2012, p.127). However, the researchers also acknowledged that when asking follow up questions to receive more useful information, one is exposed to a bigger risk of receiving biased information.

### 3.3 Design of Interview Guides

When designing the interview guide both the thematic and dynamic dimension was considered: thematic in regards to the information gains strived for based on the purpose of the study, and dynamic with regards to the interhuman relation in the interview (Kvale & Brinkmann, 2012, p.146).

The thematic dimension was structured with the theoretical framework consisting of the six categories political, economic, social, technological, legal and environmental. These academic categories were then transcribed to common used phrases and vocabulary, illustrated in figure 3 below. This was done both to avoid putting the words in the mouth of the respondent and also to take the edge of the scientific approach of the researchers, and thereby creating a more dynamic environment for the interview (Kvale & Brinkmann, 2012, p.147). The interview designs are found in appendix 1.

*Figure 3. Transcription of theoretical categories to interview questions.*

#### 3.3.1 Interviews

The target group for interviews in this study was people connected to the market for off-grid solar solutions in Nairobi Kenya. A database with off-grid companies in Kenya (Sun-connect,
2018) was used to identify and contact 32 companies active in the off-grid solar solution market in Kenya. An initial mailing to the companies found in the data-base resulted in three interviews, the other ten interviews were secured by personal contacts, referrals from professor Gatari and interview respondents. The complete list of interviews is found in table 1 below.

<table>
<thead>
<tr>
<th>Interview Number</th>
<th>Type of organisation</th>
<th>Number of respondents</th>
<th>Title of respondents</th>
<th>Date of interview</th>
<th>Reference for empirical result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Business: Cash-SHS/component</td>
<td>1</td>
<td>Head Engineer</td>
<td>2018-03-29</td>
<td>Employee Pi3</td>
</tr>
<tr>
<td>2</td>
<td>Business: Cash-PAYGO</td>
<td>3</td>
<td>Sales, Communication, and Marketing Managers</td>
<td>2018-04-09</td>
<td>Employees Pi2</td>
</tr>
<tr>
<td>3</td>
<td>Finance</td>
<td>1</td>
<td>Senior Manager</td>
<td>2018-04-10</td>
<td>Employee I1</td>
</tr>
<tr>
<td>4</td>
<td>Consultancy</td>
<td>1</td>
<td>Regional Energy Expert</td>
<td>2018-04-10</td>
<td>Employee C4</td>
</tr>
<tr>
<td>5</td>
<td>Finance</td>
<td>1</td>
<td>Regional Manager</td>
<td>2018-04-12</td>
<td>Employee I2</td>
</tr>
<tr>
<td>6</td>
<td>Business: Pico/SHS</td>
<td>1</td>
<td>Director External Affairs</td>
<td>2018-04-13</td>
<td>Employee Pa1</td>
</tr>
<tr>
<td>7</td>
<td>Business: Minigrid</td>
<td>3</td>
<td>Software and Hardware Engineers, General Manager</td>
<td>2018-04-17</td>
<td>Employees M2</td>
</tr>
<tr>
<td>8</td>
<td>Consultancy</td>
<td>1</td>
<td>Managing Partner</td>
<td>2018-04-19</td>
<td>Employee C2</td>
</tr>
<tr>
<td>9</td>
<td>Business: Cash-PAYGO</td>
<td>1</td>
<td>CEO</td>
<td>2018-04-19</td>
<td>Employee Pi1</td>
</tr>
<tr>
<td>10</td>
<td>Consultancy</td>
<td>1</td>
<td>Managing Director</td>
<td>2018-04-19</td>
<td>Employee C1</td>
</tr>
<tr>
<td>11</td>
<td>Business: Minigrid</td>
<td>1</td>
<td>Regional Manager</td>
<td>2018-04-20</td>
<td>Employee M1</td>
</tr>
<tr>
<td>12</td>
<td>Consultancy</td>
<td>1</td>
<td>Managing Director</td>
<td>2018-04-20</td>
<td>Employee C3</td>
</tr>
<tr>
<td>13</td>
<td>Business: Commercial</td>
<td>2</td>
<td>Managing Director, Business developer</td>
<td>2018-04-23</td>
<td>Employees M3</td>
</tr>
</tbody>
</table>

*Table 1. List of interviews during the period from 2018-03-29 to 2018-04-23.*
3.4 Data Analysis

3.4.1 Aggregated risk dimensions

After each interview was the recording transcribed onto paper and the answers reviewed. The Gioia (2013) methodology was used in the process of finding themes and patterns to create the analysis of the collected data. The Gioia methodology is based on three steps: 1st order concepts, 2nd order concepts and aggregated dimensions (Gioia et al., 2013).

The first order concepts are the raw data, i.e. the answers about the perceived risks. At this stage little effort is made to categorize the answers but rather to map out all the data (Gioia et al., 2013). Categorization is further done in the second order concepts, where the theoretical framework is used to find the abstract meaning of “what is going on here” in the myriad of first order concepts (Gioia et al., 2013).

When the first batch of second order concepts are found, an even higher dimension level of abstraction in applied taking in to account the theoretical framework (Gioia et al., 2013). The second order concepts are examined by the context in which they were understood, from this connecting aggregated dimensions are created.

The framework with the six risk categories illustrated in figure 2 were used together with the modified value chain illustrated in figure 4 to create the Gioia framework presented in appendix 2.

3.5 Ethical Considerations

Depending on country, certain scientific disciplines need the approval of an ethic review board before conducting a research project with people as research objects (Kvale and Brinkman, 2009, p.80,81). Though there was no need of approval from an ethic review board in this study, the research was done with an emphasize on the importance of regarding ethics and moral when conducting research.

Semi-structured interviews create some problem as static ethical guidelines are combined with qualitative research that is flexible and inductively uncertain (Birch et al., 2002, p.2). Hence as suggested on page 82-84 by Steinar Kvale and Svend Brinkmann in “Den kvalitative forskningsintervjun”, ethical guidelines were used as a rule of thumb and not as universal law. Rather with a good understanding of the ethical guidelines, the researchers tried to contextualize moral argumentation depending on the situation. As an example, it was impossible to review follow up questions in interviews in advance. Instead with a good understanding of both the market for off grid solar solutions in Kenya and the term risk in business as scientific field, together with ethical guidelines and the context of the situation, the researchers tried to make best possible choice. When considering the ethical guidelines,
mainly, consent of the informant, confidentiality and consequences, were addressed (Kvale and Brinkman, 2009, p.84,85).

3.5.1 Consent of the informant, confidentiality and consequences
Before the interview started, the respondents were briefed about the research study, the briefing included informing the respondents that they were free to leave at any point. When briefing the informant about the project, it was also taken in to account to present as little information as possible that could affect the respondent answers.

The identity of the respondents was kept anonymous, preventing any information or answers obtained in the interviews from being associated with certain informants. Certain properties of the companies were displayed for the purpose of distinction, however this information was kept to a minimum to prevent any backtracking. Apart from keeping the answers anonymous, the respondents also took in to account if the gathered information could potentially harm the off-grid solar market. In the two pilot interviews, with prof. Gatari and dr. Wambugu, cultural differences were discussed. The discussion was done to prevent any damage to be caused to the market because of cultural differences or inexperience of the authors.

3.5.2 Trustworthiness
The trustworthiness of qualitative studies is often subject to debate and various critique and questioning of validity and reliability is heard (Shenaton, 2004, p.63; Kvale and Brinkmann, 2012, p.184). To expose this problem has the four-part criteria to increase trustworthiness of naturalistic inquiries, i.e. examination of respondents in their natural settings engaging in life, conducted by Guba (1981). The four parts credibility, transferability, dependability and confirmability has been revisited by Shenaton (2004). These four criteria were addressed in the following way.

To guarantee that the answers from the respondents were of relevance for the study, the respondents respective role on the market was clearly stated. The interview objects were also chosen to represent as many different actors as possible on the market. Clearly stating the role of the respondents and interviewing a variety of different actors on the market, both help ensuring credibility of the study. To ensure transferability, a detailed description of the off-grid solar market in Kenya has been provided. Helping the reader of the report to understand in what context the study was done. A description of the research design is provided to enable others to repeat the study, ensuring dependability. When constructing the interview questions, emphasises was put on not allowing researchers’ bias influence the answers of the respondents. Together with the display of the used interview questions the aim was to ensure confirmability of the study.
4 BACKGROUND

This section provides information to the local context of Kenya in which the empirical material should be understood. The business climate, energy sector and the market for off-grid solar solutions are briefly covered and the product segments on the market are defined.

4.1 KENYA BUSINESS CLIMATE

Kenya is moving towards a market-based economy where the government acts as a regulator of competitive markets instead of participating as an actor. The Kenyan economy is one of the fastest growing economies in Sub-Saharan Africa with a growth rate of 5.8% of GDP in 2016 (world bank 2017a). The high growth is a result of macroeconomic stability, low oil prices, a rebound in tourism, strong remittance inflows and government led infrastructure development. Kenya coastal location has made it an important trading partner for neighboring countries in the region and thereby a central hub. Information and communication technology has emerged rapidly the last years, resulting in a mobile phone coverage of 88% in 2016 (CA, 2016). This has also enabled a large expansion of mobile payment solutions which offers options for financial inclusion in rural areas as well as reduced costs for money transfer. The economy has however decelerated somewhat to 4.9% in 2017 due to drought, higher oil prices and a presidential election that caused tensions for political stability. To be noted is that the decrease in growth was not as significant as one could have expected, this can be interpreted as a sign that the market has become more resilient from external macro factors like political disruptions (Dr. Anthony Wambugu, 2018). The growth is expected to rise to 5.5% and 5.9% for 2018 and 2019 respectively, where gaining access to credit for the private sector is a highlighted driver for this increase in growth (Worldbank, 2017b).

The government of Kenya aims to “transform Kenya into a newly-industrialising, middle income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment” (GoK, 2018). In this vision there are two important pillars, an improved business climate and a developed energy sector. Governmental efforts to ease the process of doing business in Kenya shows in the ranking improvements conducted annually in the report “doing business” by the World bank. Kenya has moved from rank 129 and 92 in 2015 respectively 2017, up to rank 80 out of 190 today in 2018 (Doing business, 2014;2016;2017). The business climate in Kenya is ranked higher than the surrounding area of Sub-Saharan Africa. The three categories where Kenya has notable better business climate than its average rank of 80 is, getting electricity, getting credit and protecting minority investors. The business climate for solar energy is further explained by Kangru (2018), co-founder of SolarBora, as a market with excess of “soft money” flowing into Kenya through aid and other non-profit organizations.
4.2 Kenya Energy and Electrification

Kenya places itself at 71th in the category getting electricity according to the world bank (Doing business, 2017). This relatively high ranking (out of 190) has its origin in the ambitious governmental goal of reaching a universal access to electricity in 2020 (World Bank, 2015), while climbing from rates of 26% electrification in 2012 and 47% in mid-2015 (Climate scope, 2016) to 70.3% in mid-2017 (KPLC, 2017a). Access to energy is however a difficult concept to define, the Energy Sector Management Assistance Program (ESAMP, 2015) administrated by the World Bank, has created a multi-tier framework to define the different levels and nuances of the concept. When evaluating a person's access to energy it is important to emphasize on usability rather than access. For a person to gain access to energy certain criteria must be fulfilled regarding the usability of the energy. These criteria are the following: capacity, availability, reliability, affordability, quality, legality, health impact and safety, convenience (ESAMP, 2015).

The Kenyan energy mix generating the electricity used today is dominated by hydro (31%), geothermal (27%) and petroleum (35%) energy, while solar energy only stands for 1% of the national consumption (Climate scope, 2016). Solar energy has however an important part of the governmental goal of reaching 100% electrification in 2020. The universal grid connection is expected to reach only 90% of the population and the remaining 10% in the most remote areas will be met with off-grid solar solutions (World Bank, 2017c). This creates a market for off-grid solar solutions with 1 million households comprising almost 5 million people.

4.3 Market for Off-grid Solar Solutions

Solar energy has a long history in Kenya, dating back to 1970. The development was in the beginning heavily dependent on donations but has gradually become more driven by the private market since 1990 (IREK, 2015). Products sold on the off-grid solar energy market can be divided into four categories: Pico, plug-and-play SHS, component-based systems and minigrids. A micro grid is local distribution network for electricity, that is not connected to the main grid (Hatziargyriou N, etal, 2007). With an independent energy sources, the minigrid operates decentralized from the main grid (Hatziargyriou N, etal, 2007, s1). Should be noted that the category minigrids refers to minigrids specifically powered by solar panels. To understand the differences between, pico, plug-and-play SHS and component-based systems it is required to understand the term watt peak. Watt peak is the highest possible effect that can be obtained from of a solar panel, given optimal conditions (Jelley, 2017). All of the products in pico, plug-and-play SHS and component-based systems are powered by solar panels. The individual components within these products therefore have to be adjusted to the watt peak of the solar panel, a different watt peak of a product therefore differentiates the product additionally with changes to the individual components.
Pico products have a watt peak of 0-10.999, these products include lanterns, mobile chargers and simple multi-light systems (IFC, 2018, p. 1). Products with a higher watt peak, 11 and above, are differentiated into two categories: plug-and-play SHS and components-based systems (IFC, 2018, p. 1). The differentiation is done based on how the products are being sold. SHS kits are sold as an all-in-one package, usually with powering of several lights and energy-efficient appliances (IFC, 2018, p. 1). Whereas component-based systems are sold as individual components that can be compiled independently. Examples of components in component-based systems are batteries, inverters and lights.

The market was initially dominated by pico solar systems, where the market for pico systems was boosted when Kenya was chosen as a pilot country in the Lightning Africa project in 2009. The market for pico products grew by 200% in the years between 2009-2013, with a total of 700,000 quality-certified sold units (Lightning Africa, 2018). The other two product categories have gradually expanded since 2010 (IFC, 2018, p. 1).

IFC reports of high market growth in their executive summary “Off-Grid Solar Market Trend Report 2018” with over 130 million devices sold globally since 2010. Two types of business models are distinguished relative to the payment solution of choice: cash or pay-as-you-go (paygo). Cash means up-front payment of the products while pay-as-you-go, paygo, provides a service-based energy solution using mobile payments and micro-credits. The paygo option allows the customer to first make a down payment, following up with regular payments over a period of between 6 months and 8 years. Because the initial payment is lower than with an upfront cash payment, paygo enables more customers to afford solar products. Kenya is currently the most exposed market, globally, to pay-as-you-go players, with eight different companies providing this service (IFC, 2018, p. 9). The pay-as-you-go businesses have globally also had the highest interest from investors, aggregating 773 million USD globally between 2012-2017 equal to 85% of all the funds going into the market (IFC, 2018, p. 9).

5 Empirical results

Following section is a presentation of the selected material from the 13 interviews conducted in Nairobi Kenya. This material gives insight to the local actors perceived risks on the market for off-grid solar solutions in Kenya. It is structured after the themes customers’ ability to pay, distribution and technology and access to capital which were identified as the main contexts in where the information were mentioned.
5.1 CUSTOMERS’ ABILITY TO PAY

5.1.1 Customers' knowledge
Employee Pi2 describes his/her experience of the market, as a market where many customers are first time buyers with a very limited knowledge about the product. A majority of the respondents stated that a lack of knowledge among the customers posed a risk. An example of a problem created by lack of knowledge of the customer is the following scenario described by Employees M3.

A customer walks in to the company claiming that her solar panel with battery and lamp no longer works. The technician is confused, the products had been sold merely 3 months ago. The technician asks if she can try the products located at the customer’s home and the customer agrees. At the house the light and battery works perfectly fine when tested, but as technician looks at the solar panel she sees that it is covered in dust. The technician comments the dust making the solar panel unable to work, but only receives a very confused question what the problem is.

Employees M3 says that without customer having proper knowledge about the product the customer will either underutilize or over utilize the system. Without efficient energy usage the end cost for energy usage will be significantly more expensive the respondents say.

The lack of knowledge is according to employee C1 significantly more common in rural areas, because of bad knowledge flow. Employees M3 also say that a lack of specific type of knowledge creates additional problems. Pico products according to employees M3 create a misconception of the solar technology. Customers are surprised when bigger solar systems are substantially more expensive, they do not understand the value of energy and are therefore surprised when products are more expensive than Pico. Pico is plug and play, it creates energy access but never real customer knowledge employees M3 says.

5.1.2 Factors affecting customers' revenue streams
The customer segment partly consists of farmers for many of the interviewed companies. Due to the profession of the customers, their ability to pay heavily rely on the success of the farming. Hence solar companies are greatly affected by factors affecting the farming, drought, heavy rain and other weather conditions. Farming also requires big investments at specific points in time, seasonally. Employee Pa1 experienced this phenomenon after periods of rain, after rainy periods employee Pa1 received significantly less payments. The reason for this was later discovered to be because customers used their money for seeds after rain, to plant during favourable conditions. Employee Pa1 states that, just like any other expense, the instalment of solar products competes with food and seeds. The importance of farmers being able to sell their products is also highlighted by employee I1, in an overflooded market or without
infrastructure to move goods, crops are useless. The risk of theft of the solar products is also ever present according to employee Pa1.

Customer ability to payback their loans are according to employee Pa1 and employee I2 heavily affected by political instability. The whole market crashed during last election the respondents stated, people were not making any money and therefore were not able to buy solar products. Employee Pi3 describe it as a market were all microfinancing had disappeared, the price of food had skyrocketed, people did not show up to work and post-phoned their purchases.

For Paygo companies the customer ability to pay bring an additional parameter that has to be taken in to account. This parameter is the decision of shutting of, or not shutting of the product if the customer is not pay back their loan. Employee Pi3 describes it as walking a fine line and explains it the following way; Many customers rely heavily on solar products for their generation of income, if a company shuts of their solar products, the customer will in most cases have no chance of pay back the loan. Waiting and hoping that the customer will start paying back is in some cases a better idea since the total loss of a customer is such a big loss. The return of recycling or selling old solar products are at the time very low employee I1 states, products that are shut off and laying in customers home are therefore not worth reclaiming and are simply lost revenue if they are not paid for.

5.1.3 Pricing of products
Additional costs, generated by people not paying for instance, have to be taken in to account when pricing employee Pi3 says. The pricing of the product is absolute vital for the success, employee Pa1, I2, Pi3 all clarified its importance. Without correct pricing the products never sell. Employee Pa1 say that the cost of kerosene is used as a benchmark, companies are trying to sell solar energy cheaper than the equivalence in kerosene. Employee Pa1 states that pricing for Paygo companies require the consideration of an additional factor. For Paygo companies the trade-off between longer payoff periods with smaller monthly payment and shorter payoff periods with bigger monthly payment have to be considered. With longer payoff periods and smaller monthly payments, employee Pa1 says more customers can be targeted, shorter payoff period requires higher monthly payments and fewer people can therefore afford the product. A longer payoff period though creates additional problems employee Pa1 says, with a payoff period longer than 1.5-year customer are very likely to lose attention and not pay for the product. Because of these loans, employee C2 claim that the biggest risk for Paygo companies is the default risks on the loans.
5.2 DISTRIBUTION AND TECHNOLOGY

5.2.1 Installation
Problems occurring during installation are mostly mentioned in the interviews by companies working with commercial solar systems and minigrids. Employee M3 specify weather as main factor that can negatively affect the installations of bigger systems, holes that collapse due to heavy rain for example.

Both employee M1 and employees M2 voice the problem of theft and sabotage when installing and operating minigrids, stealing of copper wires, tearing apart of smart meters. The respondents also state that these problems rarely occur if minigrids are working properly and finished on time. The local community has invested in the minigrid and are therefore keen on keeping the minigrid intact respondent state. Customers have payed deposits months in advance employees M2 says, bad communication in combination with delays can create a lot of anger. Employees M2 emphasises on the importance of communication with the customers, arranging meetings with the customers months in advance to making sure they understand what is happening. Employee C2 claim that components used for bigger installation cannot be found of the right quality in Kenya, creating an additional problem of importation.

Minigrids are in most cases built on leased land which entail the risk of not obtaining a renewal of the leases. Moving a minigrid is very expensive and complicated, the uncertainty regarding the renewal of lease is hence described by employee M1 as a big risk. Employee M1 express a concern of Pico products only fulfilling the initial need for energy. Lamps and mobile charging is only the beginning employee M1 and employee C4 state, customer will over time demand products requiring more energy. These demands will at a certain point exceed the potential of Pico products, and companies will no longer be able to satisfy their customers' need.

Employees Pi2 also voice the risk of stock disappearing. Pi2:s company have consignments agreements with resellers. These consignment agreements have in some cases proven to be unreliable and stock has disappeared from reseller without the company receiving payments.

A majority of the respondents also states that finding good partners is difficult. One of reasons for the difficulty finding partners was stated by employee Pi1 as potential partners being exclusively signed to big companies. Employee Pi3 and employee Pa1 both state that their use of commission-based sales agents create problems due to the big turnover. Apart from the problem of recruiting new agents, employee Pi3 sees an additional problem with the high turnover. The sales agents build up networks which are lost when the agents leave.

Employee Pi3, employee M1 and employee M3 all state that finding skilled labour on the market is difficult, especially experienced labour. According to employee C1, the number of licensed technicians is high, but the market demand is higher making the competition of
finding technicians harsh. Employee P1 also highlights the problem of talent poaching, salaries have to be raised greatly to avoid experienced employees leaving according to the respondent. Though the competition is harsh, almost all respondents state that the overall climate on the market is very friendly.

Reaching customer in rural areas is described as a difficult task by almost all respondents. Bad infrastructure and roads complicates the procedures, floods and security issues are also factors that complicates the distribution. Employees M2 and employee C1 both state that the density of people in rural areas are not high enough to make minigrids profitable in many cases. Access to land also pose a problem employees M3 state, especially when the land is community owned. To buy community owned land, the elders of the community have to be summoned and together agree on selling the land.

Another concern expressed by respondents is products becoming outdated quickly. According to employee I1, Paygo companies cannot have a payment plans longer than 12-18 months, the customers will otherwise find a better alternative on the market. Employee I2 describes the following experience highlighting the problem. When visiting households, it is not uncommon for employee I2 to see fully functional solar equipment that is laying on the floor unused. The equipment is outdated and the household have already bought a new set of solar products on instalment. Employees M2 describe the same problem for minigrids, though in a bigger scale. Because of the longer payoff time, the chance of a new competing technology emerging is bigger. The investments are also bigger, exposing them to bigger risks. Installations can be customized for a certain size of solar panels, when new solar panels arrive the whole installation has to be rebuilt.

Employee C2 and employees M3 both state that they are concerned about the looming threat of the grid arriving. At the moment, the grid has priority when arriving. Meaning that when a household is connected to the grid, the grid has priority selling electricity to the customer. Minigrid companies are concerned about the uncertainty of being driven out in the future due to laws. Respondents feel a lot of uncertainty regarding the interpretation of regulations when the grid arrives.

5.2.2 Challenges regarding regulations
Regulations for mini-grids in Kenya have, according to employee C1, not been instituted well enough favouring the mini-grid companies. Employee C1 says that part of the problem is that the regulations for mini-grids are not instituted specifically for mini-grids. Mini-grids are regulated by the same laws as other energy sources, resulting in tedious processes taking years to finish because of bureaucracy. Employees M3 also expressed concern regarding the lack of auditing of technicians' work, the respondents company has to repair installations frequently because of poor work from other companies. Proper measure, to stop poor work, has to be put in place employees M3 state.
In a few facilities, employee M3 even claim that companies have decided to ignore the regulations, selling energy for a higher amount than the tariffs allow. However, employees M3 adds that at these sites the customers are still willing to pay the higher amount because the energy production from other sources is still more expensive. Employee M3 describes it as, ask forgiveness rather than permission, mentality on the market.

Employee Pa1 find it hard to price their products at viable rate because the are taxed at a normal rate and their customer have a low purchasing power. The Paygo solution solves this problem partially but it entails a risk. At the moment Paygo companies are selling products on instalment but are not by law considered as a financial institution. If the government were to change perception, defining them as a financial institution, they would by law be forced to transform their organisations drastically employee I1 says.

A general concern of the respondents is rapid regulatory change. Employees Pi2 describes the following. A company import products at a certain tax rate, before the stock is sold the tax rate decreases in Kenya. The customers demand an instant decrease of the price, but the company have already payed the taxes and cannot reduce the price without making losses. Reclaiming taxes can take up to half a year Employees Pi2 says.

Tax rate increases, also poses a problem. For Pico and SHS companies the concern is the needed price increase of the product. With many customers from rural areas, on an already tight budget, a price increase can have drastic effect on their ability to afford the product employee Pi1 says.

Mini-grid companies are also affected by rapid regulatory changes. Tariff approvals needs to be renewed every year, employee M1 says that rapid regulatory changes create a degree of uncertainty regarding the outcome of the approval. If the regulatory landscape is heavily changed, predicting if the tariffs will be approved is far more difficult. Employee M1 states that the appointment of a new minister can change the regulatory landscape from being supportive to restraining, making it very unpredictable.

Employee Pi1 furthermore says that a regulatory change in itself do not pose a big problem. The problem is the short notice, sudden changes cannot be planned and adaptation is much more complicated than precautionary measures.

5.2.3 Importing difficulties

Difficulties during the import process is mutual problem for the respondents. Regulations are hard to understand and therefore also hard to follow employee C4 says. Bureaucratic processes are resource intensive and time consuming. Difficulties obtaining licenses and clearing products are problems stated by almost all respondents, much due to difficulties
distinguishing between non-solar and solar products. The government do not understand the products and therefore find it difficult to tax the them respondents say.

Employee I1 express concern regarding the difficulties for customs to tax gods. An increasing range of solar products, televisions and refrigerators, make the task of taxation very difficult. Companies improperly declaring solar products, using the favourable taxes for non-solar products, might lead to the government removing tax reliefs. Improper tax declarations create huge revenue losses for the government.

Respondents working in Pico and SHS companies highlight the problem of absence of regulations for sub-standard products. Employee Pi2 state that without regulations, the sub-standard products are allowed to enter the market freely. Kenya Bureau of Standards has to address this problem employee C1 says, setting a better general standard as quality check. The market is however improving due to the Lightning Global certification employee Pi2 says.

5.3 ACCESS TO CAPITAL

5.3.1 Available products on the market
Several respondents state the problem of in insufficient differentiation of product on the market. The market is flooded with similar products, over ten companies are making 10-watt solar panels employee Pi3 says. Respondents describe the competition on the Pico market as intense, actors pushing down the price for the end users. Employee Pi1 state that it is very beneficial for the customers, but that the competition creates the long-term risk of companies going bankrupt. Employees Pi2 describe the Pico and Paygo market no one is any profits because of the intense competition. According to employee Pa1, the market for Paygo products is almost the same, a competitive market where many actors are chasing few customers.

A majority of the respondents active on the market for solar solutions smaller than minigrids state a concern regarding counterfeit products, sub-standard products that are not evaluated regarding quality. Counterfeit products are much cheaper and create unhealthy competition employee Pi1 says. Employee C1 voice the tendency of users to be more concerned about the price of the products, and less about the quality. The respondent claims that the little concern of quality is major reason for the success of the counterfeits, indirectly creating unhealthy competition.

Employee C1 say that counterfeit products create an additional problem on the market because of their short lifespan. When a counterfeit breaking down faster than expected, there is a risk is of customers losing trust in the technology. Customers not being able to tell the difference between a counterfeit product and an original product, will think that all products are of poor quality employee C1 says. Customers will not be willing to reinvest in solar
solutions because they lost belief in the technology when the counterfeit broke down. Employees M3 also voice the concern of briefcase companies, companies that sell counterfeit goods without taking any responsibility of their quality. When the products break down, the briefcase companies are no longer active on the market and other companies have to repair and take responsibility of the counterfeit goods breaking down.

5.3.2 Uneven distribution of capital
The environment for access to capital is depicted by the respondents as an environment where some actors are receiving a lot of capital while other actors are having big difficulties in obtaining funding. Employees Pi2 and employee C4 state that mainly big Paygo companies are receiving funding. From employees Pi2 perspective Paygo companies are stealing capital meant for Pico companies. The reason for the uneven distribution of capital is described by employee Pi1 and employees Pi2 as combination of factors, one being the appealing business model of Paygo companies. With the Paygo solutions poorer customers in rural areas can be reached, which is very appealing to social entrepreneurs investing. Social entrepreneurs are stated as a common type of investor. According to employees Pi2, Paygo companies have big flashy numbers of how many people they reach, attracting investors.

Employee C4 also expresses concern of investors preferring Paygo companies because of potential access to customer data. Paygo companies receive a huge amount of consumer data from their distributed connected products, data that is very valuable to the investors employee C4 claim. Data of customers in rural areas is especially valuable, since it has not yet not been documented in this scope.

Employee C4, employees M2 all expressed concern regarding Paygo companies profitability and their massive need for capital. The reason for this is described as a rapid and aggressive growth where only the expansion has been in the focus. The big Paygo companies have only focused on obtaining a big market share, not growing in an organic and sustainable way.

Employee C4 explains the problem with Paygo companies in a similar way. Paygo companies have expanded rapidly and therefore have a lot of capital in loans granted to customers. The business model requires a lot of initial capital, but when the customers start paying back the loans the revenue streams increase and the companies becomes profitable, like valley. Many actors are now concerned that this valley is not a valley, but a never-ending slope employee C4 says. As the Paygo company sells more products they need more resources to take care of the customers, to pay for this they need to sell more products.

Employees Pi2 additionally claims that the huge funding that Paygo companies received enabled them to sell products at a very cheap price. A price that could not be matched by other companies, creating an unhealthy competition on the market.
Furthermore, respondents also state certain factors hampering the overall access to capital on the market. Employee M1 describes a case where misused capital hampered the willingness to invest in a technology as a whole, the scenario is as follows. A well-funded company decided to expand to Kenya, investing in minigrids. The company started the new business but because of lack of previous experience working in the market, bad timing and implementation hindered the expansion. Although the company failed because of inexperience working in the context, the company made the conclusion that minigrids as a business model was not profitable in Kenya. The company was not willing to invest in the solar market in Kenya any longer.

A problem of misconceptions of the market is described by a majority of the respondents. Employee C4: claims that many investors have a distorted image of Paygo companies. The conception is that Paygo companies expanded like mushrooms, extremely fast. Employee C4 claim that the rapid expansion was only possible because Pico companies had prepared the market for years by selling solar products. Without the initial understanding of the technology, the expansion would have taken a lot longer. Because of the false conception of rapid growth, employee C4 state that many Paygo companies have received big amounts of capital. Employee C4 claim investors do not poses the knowledge of how the market works on the ground, leading to investments not fulfilling expectations and investors avoiding the market.

New people receiving capital are according to employee I1 desperate, they need market shares and therefore offer very cheap product proposals. Product proposal that are not sustainable or profitable, as Paygo companies not using any deposits. Employee I1 claim that many of these desperate actors are people without business experience, naïve social entrepreneurs.

The same respondent though emphasises on the need of the big Paygo companies. The big companies bring scale and stability to the market, attributes that are beneficial for the market as a whole employee I1 says. The big size of certain companies is however a concern of many respondents, several of them state that they are afraid of one of the big actors going bankrupt. The scenario of one of the big players going down is described as a huge risk, the reputation of the market as a whole could be greatly hurt they state, leading to investors avoiding the market.

5.3.3 Local banks not investing
A majority of the respondent stated that obtaining capital from local banks is very difficult. The interest rate in Kenya is capped at 14%, which according to employee C4 makes banks unwilling to loan money to companies. The local banks consider the risks to be too great loaning money to solar companies at an interest rate of 14%. Respondents also state that the banks are more willing to lend money to the government, as they consider those loans safer and therefore prefer them. The motivation for the need of a higher interest rate than 14% is
explained by the respondents as a lack of understanding of the market. The local banks do not have accurate picture of the solar market, if they even have one, and therefore see it as risky. Employee M1 state however that if a company has a collateral, local banks are willing to loan according to respondents. Banks are according to employees M2 willing to lend money if the company has a working business in place, but to create a working business the companies need a loan for initial investments. A catch-22 as employees M2 says it.

If a company obtains a loan from a local bank it entails certain problems. Employees M3 state that the process of obtaining the money from local banks is a long and tedious. Receiving the money from a local bank can take up to a year due to administration, management and bureaucracy processes. Because of all these delays in obtaining capital from local banks, employees M3 state that in some cases local loans are not even worth it compared to international ones.

International loans entail a different problem however, several respondents state that they through international loans are affected by currency fluctuations. The international loans have to be paid back in the currency used by the investor. If the Kenya currency decreases in value, the revenue streams of the solar company can be negatively affected. For instance, employees Pi2 described a situation where they bought products from China with capital from an international loan. Before being able to sell the products, the Kenyan shilling decreased in value. Selling the products therefore did not generate the expected revenue and the company was not able to pay back the loan since the instalment had not decreased.

Obtaining international capital is however difficult for actors without international connections employee Pa1 says. Employee Pi1 state that lack of international contacts was one of the major problems when competing with bigger firms for capita. International political instability was also mentioned by employee M1 as factor affecting the access to capital. As an example, Brexit was mentioned. Brexit negatively affected international investors and indirectly employee M1 since the company was receiving less funding from the investors. Political instability within the country was also mentioned by several actors as a factor negatively affecting the access to capital. Rapid changes in politics was stated as a factor deterring investor from the market.

6 RISK ANALYSIS FOR OFF-GRID SOLAR SOLUTIONS

The risks on the market for off-grid solar solutions in Kenya has been discussed and compared with different actors in the market. To analyze the risks in the market, the framework with the six categories: political, economic, social, technological, legal and environmental risk, provided by Ioannou et al. (2017) has been applied. The risks were then further put in the context of the investors perspective and theories on perceived risks,
illustrated in figure 1, were used to explain the risks of limited and excessive access to capital for the market.

The Pico, SHS and component segment will hereafter be lumped together and referred to as the product segment. While the minigrids will be referred to as the utility segment. See section 7 for a discussion of the difference in business models for these segments. The separation in market segments is also referred to as the unregulated and regulated market for product and utility segment respectively in the context of policies and regulations.

6.1 Risk by category

6.1.1 Political risk
With the political instability connected to the election in the end of 2017, the risk associated with national economy described by Komendantova et al. (2009;2011) was very present in Kenya. Respondents reported that the economy froze and citizens in every part of society stopped their normal activities, post-phoning decisions. This created operational risks for the actors in the market, due to low sales and employees not showing up for work. The political risks include the legal system and the risks for potential legal disputes (Gatzert & Kosub, 2016, p.984). One utility company reported that certain regulations make companies’ operations illegal, but that those companies still can operate without consequences, which places them in a situation where they might face legal charges in the future. The same company explains that there has been a “ask for forgiveness rather than permission”-mentality on the regulated market which amplifies the risk for legal consequences in the future. The complex legislations and slow bureaucracy for the actors in the regulated market also pose a risk for the companies (Komendantova et al., 2011, p.4835). Tedious process for obtaining licences and getting approvals from regulatory organs, can lead to unexpected costs in terms of both money and time. This exposes the companies to delays that can have crucial effects on the companies, mainly due to technological and social risks (Jankauskas et al., 2014; Wüstenhagen et al., 2007). The regulations are considered unclear and several companies describe problems of goods being held at the port in Mombasa due to different readings of duty and clearance regulations. The delay of goods at the port adding to the risk of unexpected delays and costs.

6.1.2 Economical risk
The risk of not getting paid by the custumers for the delivered energy service is present in the whole market of off-grid solar solutions. The contributing factors differ depending on the different solutions. For the utility segment the final tariff price for electricity affects the demand for energy. As reported in the interviews might this also affect to the purchase power of the customer, given that the electricity is used for productive activities. The pricing of electricity in utility solutions is determined by certain factors like the competing price point
for energy services and customer demand (Jankauskas et al., 2014, p.119). The trade-off between the payback time and profitability of the project are also important in determining the price point. The product segment has another trade-off since their value proposition is an energy solution in the form of products. This trade-off for pay-as-you-go products is the one between the size of the deposit and the payoff period. Since the pricing always competes with the alternative cost of energy (Gatzert & Kosub, 2016), can the monthly payments not exceed these alternatives. The size of the deposit might also excludes some customers and while it provides credit safety for the company. Competing technological solutions must also be taken into account when considering the trade-off between shorter payoff time with bigger payments and longer payoff time with smaller payments (Gatzert & Kosub, 2016, p.984; Guerrero-Liquet et al., 2016, p.4). This due to the phenomena described in the interviews where the customers changed their system without finalizing the payments because a cheaper or better alternative had emerged in the market. The market has a natural risk of low demand since the targeted markets often are rural areas where as the national grid is not present. These rural areas often come with low population densities which means less accumulated demand compared to urban areas and this adds to the risk of profitability of the different value propositions. This pose a risk for the revenue outlook for the companies (Jankauskas et al., 2014, p.119).

Gaining access to finances for a project and gaining access to capital on the market are two different risk which should be separated. The risks associated with gaining access to capital for projects are analyzed in the following section and the risks of obtaining capital on the market is than analyzed in the proceeding section. Finance is crucial for a project’s success (Ioannou et al., 2017, p.604) and the landscape for accessing finances is described differently depending on the respondent. The local banks are still inactive on the market, reasons explaining the passiveness of the local banks are described by respondents as a caped interest rates and unawareness of the risks on the market. The large product companies with international networks are described as having no problem attracting international funding while the smaller players are described as having difficulties getting access to capital from international actors. The difference in access to capital leads to competitive advantages for certain companies. A concern regarding social capital adding to unfair competition have been expressed. The concern is that the unfair advantages might hurt the market reputation in the long run. Absence of local banks also leads to risk associated with fluctuations in currency which negatively affects the segments in different ways. The product segment is affected by currency risk because of capital tied to stock and capital tied to gods still being payed off. Product companies buy their products in foreign currency and sell their goods in the local currency, if the local currency where to drop in value before the gods where sold the company would make a lose. The currency risks for the utility segment is more associated to the
repayment of international loans, fluctuations in value of local currencies can affect the revenue streams and hence the ability to pay back the loans.

6.1.3 Social risk
The collected data indicates that the social risks are very present on the market. The social acceptance of solar products and electricity can be structured in accordance to Wüstenhagen et al. (2007), with socio-political, community and market acceptance. When the respondents were talking about the general reputation of the market it can be understood as the socio-political acceptance. The risk here is mainly the generalization of the different segments and actors of the market. Since most projects are depending on external finance is the financiers’ knowledge and perception of the market important. Continuing to the social acceptance of the communities, where the acceptance and understanding of the different stakeholders are important (Wüstenhagen et al., 2007). Specific for the utility is the access to land which was mentioned as extra difficult when dealing with community land. The meetings the utility companies had with the villages prior to installation and constructions witness of the importance of getting community acceptances for the projects. The product companies’ problem with high turnover from sales agents can also be added to the community acceptance, with the reading that the social relationships each sales agent builds with the customers is lost when its employment determines. The end customers knowledge and acceptance are mentioned as a key risk by many respondents. The customers experience and interaction with the products creates the market reputation that affects other customers’ willingness to buy the product or use the service. As explained by several respondents, is the market for PICO/SHS flooded with somewhat substandard products which poses a risk to the market acceptance for that specific products but also the off-grid market for solar solutions. The lack of efficient usage of electricity is also traced to the customer knowledge and the effects can lead to damaged market acceptance due to customers blaming the service provider rather than understanding that it is their consumption that is affecting the bill for electricity. Specific for the product companies with Paygo solutions is the limited payback-time that is reported to be around 18 months, where the lack of interest or motivation to pay for the products is creating a risk for default and non-payment for these companies.

6.1.4 Technological risk
When considering the technological challenges in the market the risk of components and products, malfunctioning technology is a major risk (EWEA, 2013). For the minigrid segment the consequences were exposed to the risk of theft and sabotage when the grid was out of power due to technical failure. The risk for theft was described as ever present for the product segment, since the equipment is small and designed to be easy to handle. The consequences for technical failures in this segment are described as social risks with damage to market reputation, which is the case for the products without a quality certification.
For REP the ability to connect to the grid is described as a risk (Burger et al., 2014), yet for the off-grid market, the risk is rather the uncertainty about what will happen when the grid arrives. The interviews regarding the utility segment describes the lack of regulations and confidence in the future development of the grid as big risk to the projects. The product segment is not affected in the same way since the payback time for the products are much shorter and the interviews also witness that the unreliability of the national grid strengthen the purchase power with the customers to secure the availability to electricity. The technological innovation and development is a risk (Ioannou et al., 2017) which is present in all segments. The product segment and its highly competitive market are mainly using innovation to lower the price point for the basic products where as the utility segment is faced with the risk of using components and technology that results in a higher price for electricity than new and more cost-efficient technology can deliver.

There is a difference in the risk of infrastructure as described as the availability, curtailment and mismatch of supply and demand (Gatzert & Kosub, 2016; Ioannou et al., 2017; EWEA, 2013) and the risks described in the context of infrastructure by the interviews. The mismatch between supply and demand is mainly fixed with batteries or other storage solutions and the physical infrastructure for road transport is named a risk rather than the national grid. The transport and distribution of the goods changes the infrastructural challenges from grid to road infrastructure. This difference brings the risk of using commission-based sales agents as one link in the distribution chain, the interviews from the product segment report that the high turnover amongst these agents pose a risk to the social acceptance and maintenance of the distribution channels. The competition for talent on the market is also a risk to these distribution channels used in the product segment, as well for the utility segment, since the risk of unskilled labour might lead to unexpected costs connected to construction and installation (Burger et al., 2014; Ioannou et al., 2017). The high costs for road transports and risk of damaged and stolen goods also contributes to the infrastructural risks for all segments.

6.1.5 Legal risk
The specific legal context for the market of off-grid solar solutions, is the political policy landscape which poses a risk through lacking long-term policies and quick changes in existing regulations (EWEA, 2013; Ioannou et al., 2017. p.605). The quick changes and implementations of tax and import duties on solar products poses a risk to the whole market, leaving companies with the risk of having products that they have paid tax for in stock while the competitors can import tax-free products. This creates an uncertain environment for long-term planning. Specific for the regulated market is the changes in the regulations of quality and sizing for their products and solutions leading to higher costs and either higher price for the consumer or less return for their investor. The lack of regulations in the unregulated market creates uncertainties about the future business constraints put on product companies with paygo solutions, if they were to be viewed as credit institutes instead of solar companies.
Lack of enforced quality standards in the unregulated market also pose a risk due to the problem with bad products creating misconceptions about the general technology which effects the customers’ willingness to pay. The regulated market also faces the similar problem of lacking regulations for auditing installations to quality test the licenced technicians work and thereby reduce the risk for substandard installations.

6.1.6 Environmental risk
The tropical weather conditions also have an impact on the market. Since many of the target group for the off-grid market have their main income from agriculture, are the droughts affecting their ability to pay for energy or products that provide energy. The heavy rains are also named cause for delays for construction of minigrids/commercial which adds to the natural hazards caused by the environmental risks mentioned by (Ioannou et al., 2017).

6.2 Perception of risks
Many of the risks described by the six categories above can be extrapolated to the market reputation and the risk of losing access to finance for the players active in the market. These risks are what Miranda & Glauber (1997) name as information asymmetries and other barriers that creates an uncertainty for the investor. The market reputation is essentially the accumulated knowledge of the actors, each actors’ perception of the market creates its biases for investments, as argued by Tversky & Kahneman (1974). A biased mindset weighs the potential gains and losses differently (Tversky & Kahneman, 1979) and can be understood as the reason for why there are still no local banks involved and why a lot of social capital can flow into the market from foreign investors. The different biases based on the perceived risks and expected returns has contributed to the uneven access to capital for the actors on the market today. One of the reasons for the investors bias is the access to information (Tversky & Kahneman, 1974), which is discussed by many interviewees as an important factor for the markets future access to capital. The interviews are naming the knowledge of investors and the unawareness of the differences in risks among the different segments as a main risk. The example that if one player in the market fails, weather technically or economically, it will serve as example of the market not being feasible among the investors. The lack of regulation and clarity for the future off-grid market also contributes to the information gap for the investors affecting their perceived risks and the expected returns.

7 Difference in business models
The gathered data for this study indicates that some risks are universal, and some risks are specific to different types of business segments. This is sometime explicitly noted in the interview material and sometimes understood from the context in which a specific risk is described. Richter (2012) notes that the design and operation of the business model crucial for
success of a corporation in the energy industry. With the variety of technological solutions that solar energy provides, the business model has been distinguished as one of the key factors to separate specific risks. Richter (2012) takes off in the electrical value chain when he reviews this topic and defines a scale of renewable energy business models as either customer or utility oriented. The electrical value chain starts with generation and goes through transmission, distribution and retail, before reaching the customer for consumption. This way of understanding the value proposition energy utilities does not fit perfectly in the market for off-grid solar solutions in Kenya. The main difference is that for the product segment, the distribution and retail has moved from the electrical power cables to product distribution by land transportation. The design of solar solutions, where the power generation is distributed and takes place at the site for consumption, also makes the transmission part of the value chain unnecessary. To highlight the differences between the extreme cases of business models in the off-grid market two value chains, based on the electrical value chain, is illustrated in figure 4 below. The two are called product and utility segment and represent the extreme cases on the scale for renewable energy business models by Richter (2012). The product segment comprises the Pico and SHS and component segment defined in section 4. The utility segment comprises the minigrid operators that uses distribution of electricity through power cables, retailing electricity rather than products. This way of separating the business models leaves some of the commercial installations of the component segment in the dark. Like any model or generalization, it is no perfect display of reality but rather a tool to understand the risks and the difference between the risks.

Figure 4. Application and expansion of the electricity value chain to the two market segments. The value chains are divided into a product and an energy part of the chain, where distribution and retail constitute the difference for the two segments.

The implications of the differences in business models within the market are important to note. To highlight the risks specific to either product or utility segment, the symbols white triangle and black octagon are used in the complete Gioia framework in appendix 2. The core value proposition for all segments are access to electricity. As mentioned above, the way of delivery for this value is different. The product segment uses fully decentralized generation, while the utility segment has a centralized generation. The product segment delivers products while the utility delivers electrified power outlets. This of course creates large differences in the way these companies operate their businesses.
For the product segment, the distribution channels rely heavily on the employees to distribute and sell products. This makes the companies in this segment somewhat flexible, being able to conduct their business wherever there are customers within reach. The utility segment is instead more dependent on long-term agreements with communities. This makes their relation building with the customers very important for their sales. The social risks are present in both segments, but they take form in different ways. The product segment has sales agent who builds personal relations with the customers, therefore this segment is very dependent on the individual knowledge of the sales agents. Willingness of the customers to buy the product also affects this segment greatly. The utility segment instead is dependent on the social acceptance of the local community, the local community they supply. Social acceptance often includes personal relations with many members of the local group and possibly one or few authoritative representatives.

The utility segments product delivery also comes with a commitment of maintenance which creates incentives to strive for top quality construction and installation of the site. This is also the case for the commercial installations of the component segment, where a total solution is provided. The product segment is instead dependent on their customers to handle and install the product correctly. The analytical framework would categorize both these situations with construction/installation and use of product as technological risks, though the risks are very different. Understanding the difference in business models is therefore of great importance, to differentiate risks within the categories. The technological risk of installing solar products is vastly different for the product compared to the utility segment, but the risk of improper installation is present in both segments. The business models enable an understanding for differentiating these risks.

The legal aspects also differ a lot for the two segments, a company in the utility segment is regulated as any power generating actor, meaning they are regulated the same as large hydro plants and wind farms. While the product segment is, for the moment, an unregulated market with no specific restrictions or inspections from the government. The implications from this is that the utility segment is more affected by the legal risks than the product segment which should be accounted for in comparison of the two. The overall legal system and business climate in Kenya is however a universal risk for both segments.

The misinterpretation of which risks are universal for the off-grid solar market and which are specific to some business model, can lead to further risks for the market. Both the market and technology reputation are affected by these misinterpretations. Which in turn damages the market and prevents future access to finance.
8 CONCLUSIONS

The risks for actors in the market for off-grid solar solutions can be categorized into six categories: political, economic, social, technological, legal, and environmental. The sub-categories to these areas and examples of risk events are presented in Table 2.

Furthermore, the market can be divided into two segments with different value propositions. The two segments offer both similarities and differences in terms of risks, the differences in risks can partly be explained by the separate business models and distribution channels. The two segments differentiate additionally as they are differently regulated. The product market is considered a commercial market while the utility market is required to follow stricter power generation policies by Kenyan authorities. Yet there are risks that are shared by both segments, many of which can be extrapolated to the risk of not obtaining access to finance.

<table>
<thead>
<tr>
<th>Risk category</th>
<th>Sub category</th>
<th>Risk factors/events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political</td>
<td>National economy</td>
<td>Customers stop paying</td>
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<tr>
<td></td>
<td></td>
<td>The economy freezes</td>
</tr>
<tr>
<td></td>
<td>Potential legal disputes</td>
<td>Tariff regulations create uncertainty</td>
</tr>
<tr>
<td></td>
<td>Complex legislations</td>
<td>Regulations are hard to understand</td>
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<tr>
<td></td>
<td></td>
<td>Long and tedious processes</td>
</tr>
<tr>
<td>Economic</td>
<td>Demand for energy</td>
<td>Lower demand than expected</td>
</tr>
<tr>
<td></td>
<td>Access to finance</td>
<td>Challenge to price electricity/products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low population in targeted market</td>
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<td></td>
<td></td>
<td>No local banks involved</td>
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<td></td>
<td></td>
<td>Locally capped interest rates</td>
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<td></td>
<td></td>
<td>Foreign finance tends to be “soft money”</td>
</tr>
<tr>
<td>Social</td>
<td>Socio-political acceptance</td>
<td>Damages to the market reputation</td>
</tr>
<tr>
<td></td>
<td>Community acceptance</td>
<td>Lack of knowledge from international finance</td>
</tr>
<tr>
<td></td>
<td>Market acceptance</td>
<td>Negotiation land use with local community</td>
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<td></td>
<td></td>
<td>High turnover with employees</td>
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<tr>
<td></td>
<td></td>
<td>Lack of customer knowledge/awareness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to technological reputation</td>
</tr>
<tr>
<td>Technological</td>
<td>Competing technologies</td>
<td>Technological solution becomes outdated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The national grid arrives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pico market is flooded with similar products</td>
</tr>
</tbody>
</table>
Table 2. Summary of risks, subcategories, factors and events for the market for off-grid solar solutions in Kenya.

<table>
<thead>
<tr>
<th></th>
<th>Theft and sabotage</th>
<th>People stealing products and material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unskilled labor</td>
<td>Finding experienced personnel is hard</td>
</tr>
<tr>
<td></td>
<td>Commission costs</td>
<td>Cultural difference in mindset for managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard competition for talent raises commission costs</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Legal</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Quick changes in regulations</td>
<td>Fast changes in import-taxation of products</td>
</tr>
<tr>
<td></td>
<td>Lack of regulations</td>
<td>New regulations for earthing minigrids are hastily enforced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pico market is flooded with uncertified products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uncertain definition of paygo companies as solar or credit companies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Environmental</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Natural Hazards</td>
<td>Droughts affect farmers income</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy rains complicate construction</td>
</tr>
</tbody>
</table>

8.1 FUTURE OF FINANCE AND FURTHER RESEARCH

The gap in access to finance, described by Lindleim et al. (2012), is now partly closed. Though finance is reaching entrepreneurs in the market, the capital is mainly from international investors which creates problems. The international capital has created an unfair market were only certain actors are receiving capital. No local banks are currently involved in providing credit and loans to companies on the market, leaving businesses to use international networks which certain entrepreneurs do not have.

Additionally, two factors hinder the entrepreneurs from accessing capital. The social acceptance building a market reputation and the policymakers’ ability to create trust for the regulations on the market.

When considering the difficulties of obtaining access to finance due to social acceptance, the interview answers imply that generalization is a major problem. Actors on the market express their general concern of big companies potentially going bankrupt, ruining the reputation of the market as a whole. If investors were able to distinguish the difference between actors on the market, it would be clear how different actors are exposed to different risks and should not be generalized as the same. As a purely speculative example, simply because Paygo companies are facing problems on the market, that does not entail that micro-grid companies face problems on the market.

The problem of generalization also seems to be present in risk associated with social acceptance among customers. Poor quality products in the Pico segment ruin the reputation of all products on the market, though there is a huge quality difference between products. Without the understanding of the differences between products on the market for off-grid solar solution, the customers are exposed to the risk of doing poor generalizations that do not represent reality.
This thesis was conducted to examine the risks emerged from a rapid development on the market for off-grid solar solutions in Kenya. As the UN climate goal number seven describes, cited in the introduction, is energy an essential part for people’s lives, economies and the planet. A continued positive development of the off-grid solar market is therefore of high interest for the many. The commercial market for small scale solar products is today providing basic access to electricity for the people in Kenya. The task to provide electricity to the population has however been a commitment taken on by the government historically. The distribution of off-grid solar solutions is presently done with tax reductions. Yet there is no direct support, support in the means of grants, regulations, or assistance with distribution of products. The subsidize is instead provided to the expansion of the grid which eventually will compete with the minigrids and other solar installations. If the government were to change their perspective, seeing the off-grid solar solutions as equal to the grid, the preconditions of the market would be totally different. Minigrid companies that now see the expansion of the grid as a big threat and risk, would be able to compete with the grid as equals.

It is debatable if subsidizing off-grid solar products is the best solution for future development. Depending on the technical, social and philosophical standpoint, different solutions for the future development of providing people with access to electricity in Kenya can be argued for. One solution is a free market with supporting regulations, another is a market financed and developed by national authorities. A development with rapid distribution full filling only the basic electric needs could also be a possible solution, or a development focusing on reliability and the possibly more demanding needs in the future. Regardless of which path the development take, future development of electrification policies will have considerable effect on the perceived risks on the market. With decreasing prices of solar solutions, the undeveloped grid can be considered as an opportunity. An opportunity to design a unique system customized for the specific preconditions of Kenya. This opportunity is one of many that hopefully can counterbalance the many risks, considered in this thesis. The results and conclusions of this thesis highlights the perceived risks and challenges ahead. Since lack of knowledge was identified as one of the risks for future access to finance on the market, we hope to shed some light on the risks to enlighten both present and future actors in the market.

With the fast evolving off-grid solar market in Kenya, new opportunities will bring further risks and challenges for the involved actors. From this thesis the following topics for future research are proposed: Pico and Paygo companies as solar companies or credit institutes. Universal access to electricity through expansion of national grid or subsidized off-grid solar solutions. Effects of social capital on an unregulated commercial market, short-term expansion vs long term sustainability.
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Appendix 1: Interview form

Interview questions design 1.

- Can you briefly describe the product/service you provide in the market for off-grid solar solutions?
  - Cash/Paygo?
  - Pico/SHS/component?
- Can you briefly tell us about some of the risks that are of concern to you in the market for off-grid solar solution in Kenya?
  - On the market, is there any locations or customer segments you see certain risks working with?
  - Have any events in the past affected the market and its risks?
  - (Are you active on other markets than Kenya? Do these markets differs in risk in some way?)
- We have, in preparation to this study, estimated that there are around 20-30 actors here in Nairobi. What do you think about the competition on the market?
  - There several different payment methods on the market, is there a difference in risk and limitations with them?
  - (Are there any risks connected to you as a company?)
- How is the business climate in Kenya, does it have any limiting factors today?
- What do you think of the product selection available on the market today?
  - Does it meet the demand on the market in a sufficient way?
  - Do you see any risks with the products on the market today?
    - Any specific product you feel have limitations and risks?
  - From a risk perspective, is there any reason for you choosing your product before others on the market?
- What do you think about the availability to credits and capital on the market?

Follow-up questions design 1.

- How does that affect?
- What limitations?
- What consequence does that lead to?
- Positive or negative for you?
- Any more risk you consider on this topic?
Interview questions design 2.

- **Intro – Uppsala and Nairobi university**
  - We are looking into the market for off-grid solar solutions in Kenya
  - Risk assessments by the actors active in the market
  - How long time do we have?
  - Ok if we record?

- Can you briefly describe the product or service you provide (or your role) in the market for off-grid solar solutions?
  - Cash/Paygo?
  - Pico/SHS/component?

- Can you briefly tell us about some of the risks that are of concern to you in the market for off-grid solar solution in Kenya?
  - On the market, is there any locations or customer segments you see certain risks working with?
  - Have any events in the past affected the market and its risks?
  - (Are you active on other markets than Kenya? Do these markets differs in risk in some way?)

- We have, in preparation to this study, estimated that there are around 20-30 actors here in Nairobi. What do you think about the competition on the market – in what way does is affect you?
  - There several different payment methods on the market, is there a difference in risk and limitations with them?
  - (Are there any risks connected to you as a company?)

- **What is your experience** of the business climate in Kenya, does it have any limiting factors today?
  - What about laws and bureaucracy?

- What do you think of the product selection available on the market today?
  - Does it meet the demand on the market in a sufficient way?
  - Do you see any risks with the products on the market today?
    - Any specific product you feel have limitations and risks?
  - From a risk perspective, is there any reason for you choosing your product before others on the market?

- What do you think about the availability to credits and capital on the market?
Appendix 2: Gioia framework