Barriers to Large-scale Solar Power in Tanzania

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INTRODUCTION

In September 2015, at a historic UN summit, world leaders adopted a set of goals to end poverty, protect the planet and ensure prosperity for all as part of a new sustainable development agenda (The Sustainable Development Agenda, 2016). In January 2016, the seventeen Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development (Transforming our world: the 2030 Agenda for Sustainable Development, 2015) officially came into force. Goal 7 of the SDGs is to ensure access to affordable, reliable, sustainable and modern energy for all (Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all, 2018). The challenge is significant because at the moment: (1) one in five people still lacks access to electricity, (2) three billion people rely on wood, coal, charcoal, or animal waste for cooking and heating, and (3) energy is the dominant contributor to climate change, accounting for around 60% of total global greenhouse gas emissions. Hence reducing the carbon intensity of energy is a key objective in achieving the long-term climate goals. By 2030, Goal 7 targets to: (1) ensure universal access to affordable, reliable and modern energy services, (2) increase substantially the share of renewable energy in the global energy mix, (3) double the global rate of improvement in energy efficiency, (4) enhance international cooperation to facilitate access to clean energy research and technology, and (5) expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries (in particular least developed countries) (Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all, 2018). Although the SDGs are not legally binding, governments are supposed to take ownership and establish national frameworks for the achievement of the seventeen Goals (The Sustainable Development Agenda, 2016).

There are many barriers for increasing the share of large-scale renewables in the total generated electricity worldwide. Although some countries have done much better than others in this regard, most of the developed and developing countries still face significant challenges and barriers for increasing the share of large-scale renewables into their power system. According to the International Energy Agency (IEA) (Daly & Walton, 2017), 1.2 billion people have gained access to electricity since year 2000, nearly all of them have gained access via connection to the main grid, with almost 70% of the people getting access with electricity generated from fossil fuels (45% from coal, 19% from natural gas, and 7% from oil).

Combating energy poverty, expanding electrification to population with no electricity access, and providing affordable electricity for
productive uses (to promote economic growth) are at the top of the international development policy, and often at the top of the national political agendas in the respective countries. The question is whether a good portion of the much-needed electricity will be generated from renewable resources, or the fossil fuels based generation will continue to dominate the energy mix. In the context of expanding energy access in a sustainable way, it is important to study the barriers for large-scale renewables. Identification of the most significant underlying barriers and conducting multi-dimensional analyses of these barriers is essential, if viable solutions are to be developed.

There is a lack of research based on primary data to identify the barriers to large-scale renewable energy systems in Sub-Saharan Africa, a region where most of the world’s population with no electricity access are located. Hence, our study is timely to tackle this research gap by asking the question: “What are the barriers to large-scale solar power in Tanzania?” We decided to focus on analysing the barriers to the deployment of large-scale solar power in the country, because the solar power potential - both Direct Normal Irradiance (DNI) and Global Horizontal Irradiance (GHI) - is by far the largest renewable energy resource in Tanzania (Grothoff, 2014), other than large-hydropower. Large-hydropower dominates the current Tanzanian power system generation capacity (64% of the total generated electricity in 2016), and there is a clear government support towards building new large-hydropower plants. Yet, against the backdrop of an expected ten-fold growth of power generation electricity from large-hydropower is expected to reach only 20% of the total electricity generation by 2040 (Power System Master Plan, 2016 update, 2016). If no other renewable options are explored, much of the electricity growth would come from coal and gas. The wind power potential is very limited in Tanzania (Grothoff, 2014; Wind resource mapping in Tanzania, in close-out report, 2016), the geothermal energy is still in the early assessment stages (Mnjokava, Kabaka, & Mayalla, 2015), and there is a massive and uncontrolled wood extraction from forests which is unsustainable and essentially unregulated (Malimbwi & Zahabu, 2008; Peter & Sander, 2009), so before considering biomass for electricity generation, a comprehensive biomass resource assessment study should be conducted. The solar power represents the renewable energy source (other than large-hydropower) which has the highest techno-economic potential in Tanzania (Grothoff, 2014; Personal Communications, 2016). Although some of the identified barriers may be relevant to the deployment of solar power at all scale, many of the identified barriers are specific to the deployment of large-scale solar power (e.g. regulatory frameworks, funding mechanism, financing requirements, and know-how for large-scale solar power are often different from that for small-scale solar power projects).

Answering the research question will contribute to a better understanding on the challenges that hinder the deployment of large-scale solar power in this region of the world, and how to overcome these barriers to ensure access to affordable, reliable, sustainable, and modern energy for all. To answer the research question, we focused on Tanzania as a case study in Sub-Saharan Africa, where Coal 7 of UN’s SDGs is far from being achieved. Tanzania is particularly relevant case for examining barriers to large-scale renewable energy technologies in Sub-Saharan Africa because of its past institutional efforts to support renewable energy systems (Moner-Girona et al., 2016) and the new government’s ambitious plan to boost power generation significantly over the next two decades (Tanzania’s SE4ALL action agenda, 2015).

Qualitative research has been conducted, and primary data has been collected through 30 face-to-face in-depth interviews with experts who represent the main stakeholders from the public (incl. governmental) institutions, research institutions, private investors, civil society organizations, development partners, and financial institutions. The study outcomes help decision makers, policy makers, planners, and researchers in both government and non-government organizations (e.g. development partners and international financial institutions) in understanding the different dimensions of the barriers to large-scale solar power in Tanzania. The study contributes to the existing knowledge in this field through introducing one of the earliest case studies based on extensive primary data to identify the specific barriers to large-scale solar power in one of the Sub-Saharan African countries. The paper also represents one of a few detailed case studies on identifying and analysing barriers to large-scale solar power in developing countries. Our analytical framework for analyzing the barriers uses a stakeholder-based approach that stresses the stakeholders’ perception on barriers.

**Literature review**

It is obvious that, despite the technological advances and cost reduction of Renewable Energy Technologies (RETs), there are mounting barriers preventing the renewables-based energy development to become widespread in the developing world. Painuly (Painuly, 2001) analysed the key barriers to the diffusion of RETs from a stakeholder perspective. The study identified barriers to the diffusion of RETs under six categories: market failure, market distortions, economic and financial, institutional, technical, and social-cultural-behavioural. Painuly’s analytical framework (Painuly, 2001) uses a stakeholder-based approach to analyse barriers to renewable energy penetration. The framework starts with selecting suitable RETs for a country, then collecting data about barriers to renewables, followed by analysing barriers at several levels, and ending with recommending measures to overcome the barriers.

Ahlborg and Hammars (Ahlborg & Hammar, 2014) explored drivers and barriers for rural electrification using RETs in Mozambique and Tanzania. The study used qualitative methodology, the analysis of drivers and barriers was based on the analytical framework proposed by Painuly (Painuly, 2001). Seventeen semi-structured interviews (9 in Tanzania and 8 in Mozambique) were conducted with government officials, international donors, technical consultants, and the civil society organization TaTEDO (Tanzania Traditional Energy Development and Environment Organization). The study identified political priority as the main driver for rural electrification, and pointed out that rural electrification issues are often used as election-related endowment. The study found that barriers are strongly related to the roles of national and local (rural) actors in planning and implementation. The study categorized barriers to rural electrification, as perceived by different actors, under six categories: weak institutions and organizations, economy and finance, social dimensions, technical system and local management, technology diffusion and adaption, and rural infrastructure. The study found that the most pressing barriers “are related to lack of access to human capital, to difficulties in planning and donor dependency, to low rural markets and little interest from private sector, and to more straightforward technical matters such as difficulties with installing electric equipment in traditional buildings” (Ahlborg & Hammar, 2014).

Barry, Steyn, and Brent (2009a, 2009b) identified four categories for the selection of sustainable RETs in Africa (in other words, to avoid barriers to RETs) which are: technology factors, site selection factors, economic/financial factors, and achievability by performing organization. In a later study, Barry, Steyn, and Brent (2011) tested these factors through interviewing different stakeholders from implementing agencies and end users of RETs (8 case studies in Rwanda, Tanzania and Malawi), in addition to gathering secondary data in the form of project reports and other documentation. The study confirmed the importance of all the factors that were previously identified by Barry et al. (2009a, 2009b), while identifying two new factors: government support and environmental benefits.

In their review article, Ohunakin et al. (2014) listed barriers to the development of solar energy in Nigeria which included: technological barriers (i.e. variability and intermittency of radiation, and grid unreliability), financial barriers (i.e. high initial investment cost and operation and maintenance costs), and institutional barriers (i.e. inadequate government policy and incentives, lack of awareness and information,
ineffective quality control of products, insecurity of solar plant infrastructure, and competition with other land uses). De Jongh, Choorah, and Makina (2014) explored the reasons why private investors are reluctant to invest in RETs in South Africa. The study used structured questionnaires during interviewing representatives (who make or contribute to energy projects’ investment decisions) from 10 companies located in Gauteng, South Africa. The study revealed that the four aspects that mainly influencing RETs investment decisions in South Africa are: political factors, economic factors, social factors, and technological factors. However, the study found that (De Jongh et al., 2014) “despite the influence of all the other factors investigated, the financial viability of the potential project was the most important criterion that investors considered when making investment decisions. The other major finding was that the majority of the organisations aimed at optimising return on investment”. The analysis point to the need for a closer relationship between the government and the private sector to stimulate investment and innovation in the sector.

Reddy and Painuly (2004) studied barriers to the deployment of RETs at the Maharashtra State, India. They used the stakeholder-based approach proposed by Painuly (2001) to conduct a systematic classification of the barriers to the adoption of RETs. The data was collected through a survey administered to households, personnel belonging to industry and commercial establishments, and policy experts. The stakeholders’ perceptions were collected through answering surveys and participating in stakeholder discussion work groups. The survey was designed to determine the major barriers and to specify the major factors that need to be addressed from a policy perspective (e.g. suggestions for barriers’ removal). The study grouped the barriers into six broad categories: awareness and information, financial and economic, technical, market, institutional and regulatory, and behavioural. In their review article, Nesamalar, Venkatesh, and Raja (2017) conducted literature survey to gather potential opportunities and barriers for RETs (i.e. wind, biomass, small hydro, and solar) in Tamilnadu, India.

Lidula et al. (2007) identified nineteen barrier elements to the diffusion of sustainable energy in nine developing countries among the member states of the Association of Southeast Asian Nations (ASEAN). The identified barriers range from funding/financing difficulties, through lack of awareness about RETs, lack of institutional and financial structures, limited policy framework, lack of government support, lack of research and trained personnel, to economic barriers (high up-front investment and fossil fuel subsidies). The study concluded that renewable energy related policies and regulations have to be amended at both national and regional levels.

Besides reviewing the literature on barriers in developing countries, literature on RETs diffusion barriers in developed countries has been explored in order to comprehend the complete set of possible barriers’ elements to improve our analysis. Eleftheriadis and Anagnostopoulou (2015) studied the main barriers to the diffusion of wind and Photovoltaic solar power in Greece. The study concluded that inadequate financial resources, low grid capacity, delays in the issuance of building permits, opposition from local communities, and the lack of a stable institutional framework are among the most important barriers. Policy intervention was recommended to overcome the identified barriers. McCormick and Käberger (2007) identified key barriers for bioenergy in Europe based on interviews with stakeholders in industry, research workshops, and six case studies from across the EU (located in Sweden, Finland, Austria, Poland, Italy, and the UK). The study identified economic conditions (e.g. subsidies for fossil fuels and nuclear power, besides excluding the external costs from the calculations), know-how (e.g. farmers’ minimal experience with growing, processing, storing, and transporting energy crops), and supply chain coordination as the key barriers obstructing the expansion of bioenergy in Europe.

Byrnes et al. (2013) studied barriers and challenges for the diffusion of RETs in Australia. According to the study, significant policy barriers still exist at federal and state levels. The study found that the policy landscape has favoured mature technologies -that present the lowest investment risk- at the expense of emerging alternatives (which can represent higher efficiency and emissions reduction gains). The lack of support for emerging RETs delays the accumulation of highly skilled human capital, and consequently the effective deployment of these technologies. To explore the barriers to renewable power systems in the U.S. (Sovacool, 2009) conducted semi-structured interviews with public utility commissioners, utility managers, system operators, manufacturers, researchers, business owners, and ordinary consumers. The study clustered the barriers to renewable power in the U.S. under economic impediments, political impediments, and behavioural impediments.

In their review article, Trotter, McManus, and Macanachie (2017) reviewed quantitative and qualitative electricity planning and related implementation research including 306 relevant peer-reviewed journal articles, considering each of the 49 Sub-Saharan African countries. They found that the majority of the reviewed articles expressed a preference for purely RETs solutions. The study concluded that the most frequently mentioned success factors for electrification in Sub-Saharan Africa are: adequate policy and institutional design, sufficient finance, and favourable political conditions. In other words; major barriers for the deployment of RETs in Sub-Saharan Africa can –predominantly- be categorized under “institutional” and “financial” barrier’s categories.

Our study focuses on identifying barriers to the deployment of large-scale solar power, in opposite to most of the previously discussed literature which investigates generic barriers to RETs without stating technology-specific barriers (e.g. barriers to large-scale solar power can be different than barriers to large-scale hydropower) and without stating the targeted scale of installations (e.g. small-scale vs large-scale). Only few of the previously discussed literature stated that their studies were entirely focused on small-scale RETs and/or rural electrification. The scope of our study focuses on barriers to large-scale solar power in Tanzania (under current administration of president Magufuli that introduced significant political and regulatory change) which differs from Ahlborg and Hammar (2014) empirical study that focused on barriers for rural electrification using RETs in Mozambique and Tanzania (under previous administration before 2014).

Background
There are more than one billion people (mostly in Sub-Saharan Africa and Southeast Asia) who still do not have access to electricity. The African continent has the lowest electrification rate, and more than 99% of the African population without electricity access is concentrated in Sub-Saharan Africa (Daly & Walton, 2017). In 2012, less than 21% of Tanzania’s population were connected to electricity (Tanzania’s SE4ALL action agenda, 2015). To achieve the “Tanzania Development Vision 2025”, the government identified access to modern energy as the main enabler for industrial and socio-economic transformation towards being a middle-income country by 2025 (National five year development plan 2016/17–2020/21, 2016). The government has ambitious plans, over the next two decades, to boost power generation and increase energy access with an electrification target of 50% by 2020 and 75% by 2033 (Tanzania’s SE4ALL action agenda, 2015). To achieve these targets, the government’s main strategy is to focus on large-scale power generation and grid extension (Kajage et al., 2017).

The reason for the government inclination towards expanding electrification through conventional large-scale power generation, depending mainly on natural gas and coal besides large-hydro, is seen by some studies to be associated with potential political and economic gains associated with the rents from the supply chain of the fossil fuel based electricity generation (Jacob, 2017; Barma, Kaiser, & Le, 2012). Expanding electrification is popular with Tanzanian voters, as electricity connection is seen as a sign of progress and modernity (Jacob, 2017), in this regard the investments in fossil fuel based power generation and the associated rents are seen as crucial for what Whitfield et al. (2015) call ‘the political survival of the ruling elites’. On the other hand, according to some analysts (Personal Communication, 2017a; Personal
serves are estimated around 39 trillion ft³. A strategic plan to utilize this sector include "exploring and investing in energy diversification" (Trotter & Abdullah, 2018; Tagliapietra & Bazilian, 2017; Quitzow et al., 2016). The electrification expansion in Sub-Saharan African countries is highly supported by development assistance from developed (donor) countries. It is worth mentioning that significant amounts of the current development assistance for electrification in Sub-Saharan Africa are used to directly fund non-African companies (Trotter & Abdullah, 2018). Trotter and Abdullah studied the foreign involvement in Sub-Saharan Africa's power sector, and they concluded that (Trotter & Abdullah, 2018) "a considerable majority of the U.S. development aid to the Sub-Saharan African power sector is de facto retained within the U.S. economy". The study reported that in 2016, 43 different non-African governments and 28 public sector institutions (including the 10 richest OECD countries, the EU, the UN and the World Bank) have been engaged in at least 60 electrification initiatives in Africa (Trotter & Abdullah, 2018; Tagliapietra & Bazilian, 2017; Quitzow et al., 2016).

A recent study by the International Institute for Environment and Development (IIED) (Kaijage et al., 2017) investigated the funding commitments for centralized vs decentralized energy made by the government of Tanzania and its development partners (i.e. development partners are bilateral and multilateral donor organizations) concludes that "the vast majority of funding for energy projects from both international funders and domestic budgets goes to large on-grid energy projects such as grid expansion". According to the study, between 2009-10 and 2016-17 the government of Tanzania allocated nearly USD 2 billion to energy access, of which 98% was targeted to grid-based energy projects. While between 2008 and 2021 development partners provided (or

1 The Ministry of Energy and Minerals (MEM) was split by the Tanzanian president in October 2017 to the Ministry of Energy and the Ministry of Minerals. As our data collection (and interviews) has taken place before this recent development, we refer to the energy ministry in this study as MEM.
The European development partners working in Tanzania have clear mandates to focus their aid and investment schemes on renewable energy projects (Personal Communication, 2017d). On the other side, the African Development Bank (AfDB) supports the development of coal-fired power projects. The former president of the AfDB, Donald Kaberuka, stated this message in March 2015 (Mwiti, 2015): “It is hypocritical for western governments who have funded their industrialisation using fossil fuels, providing their citizens with enough power, to say to African countries: You cannot develop dams, you cannot develop coal, just rely on these very expensive renewables”.

In July 2017, the Government of Japan and the AfDB have signed a letter of intent to launch the Japan-Africa Energy Initiative (JAEI), when the following message of the Deputy Prime Minister and Minister of Finance of Japan was conveyed (AfDB and Government of Japan launch Japan-Africa Energy Initiative, 2017): “We strongly hope that, through this initiative, Japan can contribute to accelerating the provision of electricity in Africa, including through its best available low-emitting clean coal technologies, thus leading to inclusive and sustainable growth in Africa”. Under this initiative, the AfDB will take the lead in projects’ development while Japan stands ready to provide up to USD 6 billion in both concessional and non-concessional finance for a variety of energy operations (AFDB and Government of Japan launch Japan-Africa Energy Initiative, 2017). The Japanese International Cooperation Agency (JICA) collaborated with the Tanzanian government in preparing the Natural Gas Utilization Master Plan (Natural Gas Utilization Master Plan 2016–2045 (NGUMP), 2017) and the Power System Master Plan (Power System Master Plan, 2016 update, 2016) which emphasizes the role of coal and gas-fired power generation. According to TANESCO3 (Personal Communication, 2017c), Japan is in the forefront for supporting gas-fired power plants in Tanzania.4

### Methodology

When introducing new electricity generation technologies in a country or a region, stakeholders influence significantly the decision making process and therefore their views and perceptions on the barriers to large-scale renewables are very crucial. Hence we decided to use a stakeholder-based approach which stresses the perceptions of the stakeholders on the barriers. Fig. 3 illustrates the used qualitative methodology. Firstly, we conducted an extensive secondary data collection (Grothoff, 2014; Wind resource mapping in Tanzania, in close-out report, 2016; Mnjokava et al., 2015; Malimbwi & Zahabu, 2008; Peter & Sander, 2009; Aly, Jensen, & Pedersen, 2017; Hammel, 2011) in addition to conducting 27 expert consultation sessions in Dar es Salaam in June 2016 (Personal Communications, 2016) to identify the large-scale renewable energy technologies with the highest potential in Tanzania. The experts were selected from various governmental agencies, research institutions, private investors, financial institutions, and civil society organizations involved in the Tanzanian electricity sector. Solar power technologies were identified as the large-scale renewable energy technologies (other than large-hydropower) which have the highest techno-economic potential in Tanzania (Grothoff, 2014; Aly et al., 2017; Bernards et al., 2015; Aly et al., 2018).

The second phase “Stakeholder Analysis and Stakeholder Inputs” aimed to define the dynamics of the Tanzanian electricity sector from the stakeholders’ perspective. The stakeholder analysis is crucial to “generating knowledge about the relevant actors” (Mikkelsen, 2005) and to identify the stakeholder interrelations, agendas and influence on decision-making processes (Guion, 2002). Chambers (Guion, 2002) stressed the importance of the stakeholder analysis as it shows “the powerful and well connected stakeholders which can have a greater influence on decision-making outcomes than more marginalised groups”. Hence, in addition to the conducted secondary data collection to initially understand the dynamics of the Tanzanian electricity sector, we conducted 30 in-depth interviews with the main electricity sector’s stakeholders in Tanzania during September 2017. The interviewed stakeholders included representatives from: public (governmental) institutions, research institutions, private investors, civil society organizations, development partners, and financial institutions. The interviewees were selected on the basis of their experience of the renewable energy development in Tanzania. Snowball technique was used to identify all the main stakeholders who have a role in decision-making.

The interviews were semi-structured, i.e. asking open-ended questions facilitated by an interview guide, and framing the questions taking into consideration the professional experience of the interviewed expert (Mikkelsen, 2005). The semi-structured interviews were focused...
on topics centred around barriers to large-scale solar power technologies, while allowing interviewees to reflect on their own answers and bring up additional aspects that they find relevant or important. Interviews were recorded (except two interviews which were not allowed to be recorded), transcribed, and then analysed using a deductive approach to identify barriers in an iterative process (Mikkelsen, 2005).

The interviews covered four main themes: (1) discussion on the targets presented at the latest Power System Master Plan and the official direction to depend on centralized conventional power generation with massive transmission plans, (2) extended discussion on the barriers for large-scale solar power in Tanzania, (3) discussion on the role of the development partners in the Tanzanian energy sector, and (4) discussion on the engagement of the financial institutions in the Tanzanian power sector.

Finally, we conducted a “Multi-level Barriers Identification and Barriers Analysis”. The identified barriers have been explored and analysed...
at several levels (Painuly, 2001). The top level (first level) is the broad barrier category (e.g. financial barriers) and the lower levels consider more details and specifics. Hence at the second level, various barriers -within a category- are analysed (e.g. high cost of capital ... etc.). At the third level, various elements of these barriers are studied (e.g. high interest rate ... etc.). The presence of barriers can be identified through a bottom-up approach. Hence, a barrier or a barrier category is considered only when the presence of at least one of its components at a lower level is existing (Painuly, 2001).

We found that giving the stakeholders the freedom to express what they consider as barriers to large-scale renewables -without any preconditions- is quite effective. This approach helped us to understand the stakeholders’ behaviour, interests, agendas, and influence on the decision-making process (e.g. by noticing which barriers each stakeholder start with, or find most important, or try to avoid admitting their existence ... etc.). It could be argued that stakeholders are often reluctant to admit (and mention) barriers which they are responsible for. We tracked this behaviour in our analysis (e.g. when a stakeholders refer all the barriers to other stakeholders, and see that it is not responsible to any of the existing barriers).

Our analysis of barriers to large-scale solar power has been conducted with insights from Painuly’s analytical framework (Painuly, 2001) which uses a stakeholder-based approach to analyse barriers to renewable energy penetration. The framework starts with selecting suitable renewable energy technologies for a country, then collecting data about barriers to renewables, followed by analysing barrier at several levels, and ending with recommending measures to overcome the identified barriers. The main modifications we introduced to Painuly’s analytical framework are: (1) centring our data collection on in-depth stakeholders’ interviews, (2) conducting semi-structured interviews with the stakeholders to investigate their perceptions (first impressions) on the barriers rather than preparing survey (i.e. questionnaire) or structured interviews that list all possible barriers and ask them to confirm and rank each barrier’s elements, and (3) focusing our barriers analysis on the stakeholders’ perceptions on barriers.

As a qualitative approach has been used, it is important to keep in mind some important aspects linked to this type of approach. Although the interviewees are very knowledgeable in their field, the analysis reflects what stakeholders found important and relevant at a specific point in time. The English language was used to conduct all interviews, yet there is always a risk of misunderstanding as regards language. Although inconsistencies are addressed through triangulation of findings (Guion, 2002), only some facts can be triangulated, hence differing (sometime contradicting) views, narratives, and perceptions are considered as part of the results. Possible biases in interviews (i.e. the concepts of reliability and validity) are discussed in details for this type of qualitative analysis in (Mikkelsen, 2005). As Alvesson and Sköldberg (2017) put it “[... ] there is no such things as unmediated data or facts; these are always the results of interpretations. Yet the interpretation does not take place in a neutral, apolitical, ideology-free space. Nor is an autonomous, value-free researcher responsible for it”.

Analysis and discussion

Stakeholder analysis

The stakeholders who have a role in decision-making were identified under six groups, namely: public (incl. governmental) institutions, research institutions, private investors, civil society organizations, development partners, and financial institutions. Nine interviews were conducted with stakeholders from public institutions: four interviews with representatives from TANESCO (investment, training, research, and transmission departments), two interviews with representatives from the Ministry of Energy and Minerals (MEM), an interview with representatives from the Energy and Water Utilities Authority (EWURA),5 an interview with a representative from the Rural Energy Agency (REA), and an interview with a representative from the Department of Environment. Two interviews were conducted with stakeholders from research institutions: an interview with a representative from the University of Dar es Salaam (UDSM) and an interview with a representative from the Tanzania Commission for Science and Technology (COSTECH). Three interviews were conducted with private investors: an interview with representatives from ENERG Verda Africa Ltd., an interview with a representative from Frontier Investment Management, and an interview with a representative from Windlab. Five interviews were conducted with stakeholders from civil society organizations: an interview with a representative from Tanzania Renewable Energy Association (TAREA), an interview with a representative from Tanzania Traditional Energy Development and Environment Organization (TaTEDO), an interview with a representative from the World Wildlife Fund (WWF), an interview with a representative from Tanzania Youth Coalition (TYC), and an interview with a representative from the Climate Action Network (CAN). Eight interviews were conducted with development partners: an interview with representatives from the Danish International Development Agency (DANIDA), an interview with a representative from the Norwegian Agency for Development Cooperation (Norad), an interview with representatives from the Swedish International Development Cooperation Agency (Sida), an interview with a representative from the Delegation of the European Union to Tanzania, an interview with representatives

5 The Energy and Water Utilities Authority (EWURA) is an autonomous and multi-sectoral regulatory authority established in February 2006. EWURA is responsible for technical and economic regulation of the electricity, petroleum, natural gas and water sectors in Tanzania.
Table 1
Stakeholder perceptions on the dynamics of the Tanzanian electricity sector.

| Theme                                                                 | Public institutions | Research institutions | Private investors | Civil society organizations | Development partners | Financial institutions |
|----------------------------------------------------------------------|---------------------|-----------------------|-------------------|-----------------------------|----------------------|-----------------------|
| Perceptions/statements by stakeholder’s groups                       |                     |                       |                   |                             |                      |                       |
| **Institutional and political-related themes**                       |                     |                       |                   |                             |                      |                       |
| New direction on energy planning (associated with the directions of president Magufuli’s new administration) |                     |                       |                   |                             |                      |                       |
| The new government proceeds mostly with government-owned power projects trying to prevent corruption (e.g. previous overpriced contracts awarded to private-owned projects). | -                   | -                     | -                 | -                           | -                    | -                     |
| The new government favours the Engineering, Procurement, Construction and Financing (EPCF) model through competitive bidding process instead of the previous Independent Power Producer (IPP) model. | -                   | -                     | -                 | -                           | -                    | -                     |
| The new legislation related to the frameworks governing natural resources restricts the business environment. | -                   | -                     | -                 | -                           | -                    | -                     |
| Need of strengthening coordination between energy-related and environment-related public institutions. | -                   | -                     | -                 | -                           | -                    | -                     |
| Unwillingness to invest in renewable energy projects without a guarantee for a minimum off-take from TANESCO or sovereign guarantee from the government. | -                   | -                     | -                 | -                           | -                    | -                     |
| The government is currently giving the highest priority to gas-fired power plants (in terms of financing and construction). | -                   | -                     | -                 | -                           | -                    | -                     |
| Economic development (often associated with large-scale conventional power plants) is prioritized over environmental and social impacts. | -                   | -                     | -                 | -                           | -                    | -                     |
| Reaching the electricity generation target stated in the latest Power System Master Plan (i.e. 21 GW installed capacity by 2040) is non-realistic. | -                   | -                     | -                 | -                           | -                    | -                     |
| **Finance-related themes**                                            |                     |                       |                   |                             |                      |                       |
| Financing options for new electricity generation projects             | -                   | -                     | -                 | -                           | -                    | -                     |
| Commercial Tanzanian banks and other local lending institutions are not yet engaged in funding large-scale electricity generation projects (either fossil fuel-based or renewable energy-based). | -                   | -                     | -                 | -                           | -                    | -                     |
| European development partners will not finance coal-fired power projects in Tanzania, they are interested in supporting renewable energy projects. | -                   | -                     | -                 | -                           | -                    | -                     |
| Large-scale solar power projects are more difficult to be financed compared to conventional (fossil-fuel based) projects. | -                   | -                     | -                 | -                           | -                    | -                     |
| The government is interested in the lowest cost electricity generation technologies, and there is a perception within the government that solar power technologies are quite expensive. | -                   | -                     | -                 | -                           | -                    | -                     |
| In Tanzania, government-supported energy projects can access favourable financing conditions from the Development Finance Institutions (e.g. grants or concessional loans at 3-7% interest rate), while private investors interested in financing solar power projects negotiate a debt interest rate in the range of 20%. Unwillingness of private investors to invest in renewable energy projects without a guarantee for a minimum off-take from TANESCO or sovereign guarantee from the government. | -                   | -                     | -                 | -                           | -                    | -                     |
| **Technology-related themes**                                         |                     |                       |                   |                             |                      |                       |
| Central generation approach (based on conventional technologies plus massive grid extension) versus integrating new renewable energy-based technologies | -                   | -                     | -                 | -                           | -                    | -                     |
| The mainstream direction of the government is to follow the latest Power System Master Plan (focusing massively on gas and coal-fired power plants till 2040). | -                   | -                     | -                 | -                           | -                    | -                     |
| The quality of Tanzanian coal is not up to the standard for electricity generation (i.e. low calorific value). Transmission grid will be constructed before the centralized generation will be commissioned. Large-scale solar power technologies are intermittent and unreliable, hence their integration to the Tanzanian power system should be limited. Otherwise massive and expensive electricity storage facilities will be needed. | -                   | -                     | -                 | -                           | -                    | -                     |
| Renewable energy projects in Tanzania are driven by private investors, development partners, and civil society organizations. | -                   | -                     | -                 | -                           | -                    | -                     |
| Projects based on conventional electricity generation technologies (e.g. gas- and coal-fired power plants) are mainly backed/led by the government. | -                   | -                     | -                 | -                           | -                    | -                     |
| Most of the conventional large-scale power plants and transmission projects are financed through international financial institutions. | -                   | -                     | -                 | -                           | -                    | -                     |

- Less than 1/3 of the interviewees in this stakeholder cluster showed (addressed) this perception.
- Between 1/3 and 2/3 of the interviewees in this stakeholder cluster showed (addressed) this perception.
- More than 2/3 of the interviewees in this stakeholder cluster showed (addressed) this perception.

The quantitative signals are indicative, results can’t be generalized for the entire population.
from the U.S. Agency for International Development (USAID), an interview with representatives from the German Corporation for International Cooperation (GIZ), an interview with a representative from the French Development Agency (AFD), and an interview with representatives from Japan International Cooperation Agency (JICA). Three interviews were conducted with stakeholders from financial institutions: an interview with a representative from the African Development Bank (AfDB), an interview with a representative from the German Development Bank (KfW), and an interview with a representative from the Export-Import Bank of Korea (Korea Eximbank).

The 30 semi-structured interviews allowed capturing the main perceptions (i.e. drivers) and interests of the stakeholders on the electricity sector's status quo in Tanzania. In order to provide a linkage between stakeholder’s perceptions and barriers we performed an exhaustive analysis of the interviews. The result of the in-depth interview analysis allowed us to classify the main drivers for the six stakeholder’s clusters analysis of the interviews. The result of the in-depth interview analysis showed that the main drivers for the six stakeholder’s clusters were identified through the thematic analysis of the interviews. The result of the in-depth interview analysis allowed us to classify the main drivers for the six stakeholder’s clusters analysis of the interviews. The result of the in-depth interview analysis allowed us to classify the main drivers for the six stakeholder’s clusters analysis of the interviews. The result of the in-depth interview analysis allowed us to classify the main drivers for the six stakeholder’s clusters analysis of the interviews.

As shown in Table 1 stakeholder groups often has different perceptions (sometimes leading to conflicting interests) on many of the themes. It is important to understand the diverse range of potentially conflicting stakeholders’ interests (Friedman & Miles, 2006; Prell et al., 2007; Reed et al., 2009). To understand the potential of the stakeholder groups for creating alliances and estimating their level of influence, we plotted the positions of the stakeholder’s groups in Fig. 4, where the horizontal axis represents the perception of the stakeholder’s groups about large-scale solar power projects (from negative to positive), while the vertical axis represents the ability of the stakeholder’s groups to impact the deployment of large-scale solar power projects (from low to high). The positioning is based on our analysis (e.g. secondary data collection and conclusions after interviewing the stakeholders). We noticed a clear stakeholder’s group position shifting for the government, international financial institutions, and European development partners before (grey colour) and after (blue colour) the new administration took office in November 2015. The transition between positions is indicated by arrows that shows the direction of the shift (e.g. currently the government has higher ability to impact the projects and rather negative view on the large-scale solar power projects). The aim of Fig. 4 is to show the shift in the stakeholder’s group positions rather than to indicate the exact precise position of each stakeholder’s group.

### Barriers’ analysis

Our study categorizes barriers to large-scale solar power as perceived by the interviewed stakeholders (from public institutions, research institutions, private investors, civil society organizations, development partners, and financial institutions). This is a major difference between our applied analytical framework and the framework proposed by Painuly (2001) and followed by number of the studies discussed previously where the researchers play a pivotal role in identifying the barriers prior to interviewing (or surveying) the stakeholders based on secondary data collection. We found that all the barriers mentioned by the interviewed stakeholders are either directly named (or can be categorized under) three barrier’s categories: institutional barriers, financial barrier, and technological barriers.

Although some of the barriers clustered under “institutional barriers” could be named as political barriers (e.g. political interference in the decisions of the utility and the regulator) or as awareness barriers (e.g. decision makers’ perception that solar power technologies cannot be used for large-scale generation), we preferred to include them under the “institutional barriers” category because they have been mentioned as institutional barriers by the interviewed stakeholders, clustering some of them under different category (e.g. political or awareness barriers) will be only a matter of definition which may cause unwanted confusion. In the literature on barriers (Painuly, 2001), “institutional barriers” category has been found to include absence of institutional structures and mechanisms, in addition to practices that act as barriers (e.g. such practices might be linked to behavioural, social, or cultural dimensions). Although the barrier “technical limit set by the utility for electricity generation from renewable energy to be below 10% of the overall power system capacity” clustered under “technological barriers” could be named as know-how barrier or awareness barrier, as it is not a correct technical limit (as it will be discussed later). We preferred to include this barrier under the “technological barriers” category because it was mentioned as (i.e. perceived as) technological barrier by the interviewed stakeholders.

None of the interviewed stakeholders referred to (or named) an explicit social barrier for large-scale solar power projects in Tanzania. An interpretation that may explain why interviewed stakeholders have not mentioned social barriers is that, in Tanzania, social barriers are often seen as a relevant barrier category to small-scale RETs projects rather than to large-scale solar power projects which is often not located in densely populated areas. To elaborate with an example, when Ahlborg and Hammar (2014) explored barriers for rural electrification using RETs in Mozambique and Tanzania, the “social dimensions” barrier...
category included elements related to small-scale renewables (off-grid, mini-grids, or Solar Home Systems) like: poverty and low household affordability, lack of local engagement and capacity, problems in local participation and theft, change of mind among costumers, and gender issues. An interpretation that explains why interviewed stakeholders have not mentioned social barriers can be the perception that large-scale solar power projects in Tanzania will not be hindered due to social barriers, in case political will, supportive institutional and policy framework, and availability of financing and technology are in place.

Environmental barriers for large-scale solar power projects in Tanzania have not been mentioned by any of the interviewed stakeholders. Although there are environmental impacts for large-scale solar power installations (Hernandez et al., 2014) (e.g. impacts on biodiversity – incl. birds, bats, and insects-, soil, water consumption, and human health), such environmental impacts are often seen as minor impacts when compared to the environmental impacts of fossil fuel-based electricity generation technologies or large-hydropower. An interpretation that may explain why interviewed stakeholders have not mentioned environmental barriers can be the perception that large-scale solar power projects in Tanzania will not be hindered due to environmental barriers, in case political will, supportive institutional and policy framework, and availability of financing and technology are in place. Similarly, competition with other land uses has not been mentioned as a barrier to large-scale solar power in Tanzania by any of the interviewed stakeholders. This viewpoint can be justified, as Tanzania (a country of approx. 1 million km²) possesses abundant available land for large-scale solar power installation which has no competition with other land uses. Aly et al. (2017) conducted a detailed study to investigate the spatial suitability of large-scale solar power (incl. Concentrated Solar Power and utility-scale Photovoltaics technologies) in Tanzania, the study excluded all unsuitable areas large-scale solar power installation (including lands designated as protected areas, cultivated or managed land, woody and trees, shrub, and natural aquatic vegetation, and lands expected to be used for future urban expansion). The study concluded that (after excluding all unsuitable areas and considering seven ranking criteria) for Concentrated Solar Power installations, 3584 km² was designated as most suitable, 21,523 km² was designated as suitable, and 20,184 km² was designated as moderately suitable. For utility-scale Photovoltaics installations, 20,801 km² was designated as most suitable, 68,848 km² was designated as suitable, and 78,133 km² was designated as moderately suitable.

The interviewed stakeholders have been asked to indicate the most significant barrier’s category (i.e. institutional, financial, or technological) that hinder the deployment of large-scale renewables in Tanzania. Most of the interviewed stakeholders from research institutions (Personal Communication, 2017a), private investors (Personal Communication, 2017e), civil society organizations (Personal Communication, 2017b), development partners (Personal Communication, 2017d), and financial institutions (Personal Communication, 2017f) stated clearly that the most significant barrier’s category is “institutional” barriers which often leads to “financial” barriers. Most of the interviewed stakeholders from public -governmental- institutions (Personal Communication, 2017c) stated that the most significant barrier category is “financial” barriers followed by “technological” barriers. Many of the interviewed stakeholders from public institutions (Personal Communication, 2017c) stated clearly that there are no “institutional” barriers that hinder the deployment of large-scale renewables in Tanzania. Table 2 summarizes the identified barriers under the three main categories: institutional, financial, and technological. Each barrier category has been analysed at two-levels (barriers and barrier’s elements).

**Institutional barriers**

Uncertainty around the government’s commitment towards large-scale solar power. The most dominant institutional barrier is the uncertainty around the government’s commitment towards large-scale solar power projects. The current government approach is to proceed with government-owned power generation projects. As the government’s financial resources are limited, some priority projects have to be identified. According to the official Power System Master Plan (Power System Master Plan, 2016 update, 2016) and the interviews with representatives from public (incl. governmental) institutions (Personal Communication, 2017c), large-scale solar power projects are not on the government agenda at the moment.

Many important decisions in the power sector are made by the political leaders rather than by technocrats, hence every new administration has a significant impact on the direction of the power sector (e.g. different priorities⁶) (Personal Communication, 2017c). The unpredictability on the government’s priorities related to the power sector imposes significant uncertainty about the future investment planning for large-scale solar power projects. All the interviewed private investors (Personal Communication, 2017e), six out of the eight interviewed development partners (Personal Communication, 2017d), three out of the five interviewed civil society organizations (Personal Communication, 2017b), and two of the interviewed financial institutions’ representatives (Personal Communication, 2017f) see that the government commitment and the policy environment around renewables is completely unpredictable which is leading to a very high uncertainty perception. Some of the interviewed development partners’ representatives (Personal Communication, 2017d) see that large-scale solar power projects are supposed to be implemented by signing Power Purchase Agreement (PPA) with TANESCO through a competitive bidding process, but this process has been put on hold for more than three years (since 2015) and no one knows when or whether it will be resumed again (Personal Communication, 2017e).

Decision makers’ perception that solar power cannot be used for large-scale generation. Another institutional barrier is the decision makers’ perception that solar power technologies cannot be used for large-scale generation. Most of the interviewed investors (Personal Communication, 2017e), financial institutions’ representatives (Personal Communication, 2017f), and development partners (Personal Communication, 2017d) see that the high-profile decision makers in Tanzania don’t believe that solar power technologies can generate reliable electricity in large amount (e.g. tens of MW scale) to contribute to the country’s industrialization vision. The general perception, within public institutions, is that solar power technologies can only provide intermittent non-reliable electricity on small-scale (e.g. Solar Home System or mini-grid). There is an obvious political preference towards visible large-scale electricity generation projects that can contribute to the country’s industrialization vision.

Discouraging business environment for private investors. A further institutional barrier is that in Tanzania there is a discouraging business environment for the private investors who are interested in large-scale solar power projects. The new legislation on the natural resources (discussed in the Background section) which reinforces the sovereignty of the Tanzanian state on business contracts is perceived by most of the stakeholders (Personal Communication, 2017d; Personal Communication, 2017e; Personal Communication, 2017f) as a very discouraging measure for private investment in related sectors (including renewable energy). On the other hand, the new legislation is seen by the Tanzanian government as necessary measures to avoid and corrupt based on the country previous experience in this regard.

Under the new legislation, the Tanzanian government has the power to review any natural resources-related contract, if it is assessed to be contrary to the national interest (e.g. too expensive) (Personal Communication, 2017e).
Table 2
Multi-level barrier identification.

| Barrier                                                                 | Public institutions | Research institutions | Private investors | Civil society | Development partners | Financial institutions | Institutional barriers |
|------------------------------------------------------------------------|---------------------|-----------------------|-------------------|---------------|----------------------|------------------------|------------------------|
| Uncertainty around the government commitment towards large-scale solar power projects | ○                   | ○                     | ●●               | ●●            | ●●                   | ●                      | Large-scale solar power projects are not among the government’s electricity generation priorities at the moment |
| Decision makers’ perception that solar power technologies cannot be used for large-scale generation | ○                   | ○                     | ●●               | ●●            | ●●                   | ●                      | Discontinuity of the power sector directions and priorities, therefore a high risk perception |
| Discouraging business environment for the private investors interested in large-scale solar power projects | ○                   | ○                     | ●●               | ●●            | ●●                   | ●                      | Government commitment and the policy environment around large-scale solar power are unpredictable |
| Single-digit tariff cap suggested by the government                     | ○                   | ○                     | ●●               | ●●            | ●●                   | ●                      | competitive bidding process for large-scale solar power is on hold, it is not clear when or whether it will be resumed again |
| Political interference in the decisions of the utility and the regulator | ●                   | ○                     | ○●               | ○●            | ●●                   | ●                      | Perception that solar power technologies can only provide intermittent electricity on small-scale |

| Financial barriers                                                                 |                      |                      |                      |                |
|-------------------------------------------------------------------------------------|----------------------|----------------------|-------------------|-------------------|
| Off-taker non-payment risk                                                           | ●●                   | ○                     | ●●               | ●●              | Solar power projects are considered small projects with uncertain revenue (often linked with the intermittency of their electricity generation) |
| Unfavourable financing conditions for large-scale solar power projects              | ●●                   | ●●                   | ●●               | ●●            | Tanzanian financial institutions often prefer a short lending tenor, which is impractical for large-scale solar power projects |
|                                                                                      |                      |                      |                  |                | International financial institutions usually consider very high interest rate for large-scale solar power projects in Tanzania to account for the high associated risks |

| Technological barriers                                                                 |                      |                      |                      |                |
|-------------------------------------------------------------------------------------|----------------------|----------------------|-------------------|-------------------|
| Lack of data and studies to support large-scale solar power projects                 | ●                    | ●                    | ●●               | ●●              | Lack of data and studies on solar energy resource assessment |
| Lack of qualified local personnel                                                   | ●●                   | ●                    | ●●               | ○●            | Lack of economic and financial studies that elaborate on the potential cost and revenue of large-scale solar power projects under the Tanzanian business environment |
| Technical limit set by the utility for electricity generation from renewable energy to be below 10% of the overall power system capacity | ●●                   | ●                    | ○●               | ●●            | Lack of qualified local personnel who have the capacity to design, build, and operate large-scale solar power projects at technical, business, and managerial levels |
|                                                                                      |                      |                      |                  |                | Tanzanian graduates lack the practical experience and training due to the lack of laboratories and training facilities, in addition to the lack of real large-scale solar power projects in the country where the students can engage and get first-hand practical experience |
|                                                                                      |                      |                      |                  |                | Lack of expertise in large-scale solar power projects at some public institutions responsible for planning and decision making in the electricity sector |
|                                                                                      |                      |                      |                  |                | Lack of technical capacity in the local Tanzanian companies for designing and preparing business proposals with high standards which meet international funders’ requirements |
|                                                                                      |                      |                      |                  |                | Perception that renewables are intermittent electricity generation technologies which cannot contribute to the power system’s base load or firm capacity |
|                                                                                      |                      |                      |                  |                | Perception that renewables are not capable of contributing to the power system services (i.e. offering primary and secondary reserves) to ensure the stability of the system |

● None of the interviewees in this stakeholder cluster addressed this barrier.
○ Less than one third of the interviewees in this stakeholder cluster addressed this barrier.
●● More than two thirds of the interviewees in this stakeholder cluster addressed this barrier.
○● Less than two third of the interviewees in this stakeholder cluster addressed this barrier.
●●● Two third or more of the interviewees in this stakeholder cluster addressed this barrier.

The quantitative signals are indicative, results can’t be generalized for the entire population.
A couple of the interviewed development partners (Personal Communication, 2017d) find that some aspects of the new legislation are vague and its interpretation can be subjective which make it hard for legal advisors to make concrete legal advice for investors willing to invest in large-scale solar power projects. A couple of the interviewed financial institutions’ representatives (Personal Communication, 2017f) and development partners (Personal Communication, 2017d) see the imposition of national arbitration despite international treaties and despite bilateral agreement as a discouraging measure for private investment in the country. Most of the new large-scale power projects will be state-owned. Consequently, in case of a conflict, the private investors (who are expected to finance, design, construct, and operate the power plants) have some fears that the national judiciary system could be biased towards the government side.

According to the new government’s direction, all large-scale power projects will be announced for an Engineering, Procurement, Construction and Financing (EPCF) model through a competitive bidding process (Personal Communication, 2017c; Personal Communication, 2017d). The EPCF model implies that the project will be built (and initially financed) by the private investor, then (after a pre-determined period) the project will be procured and owned by the state. According to one of the interviewees from TANESCO (Personal Communication, 2017c), TANESCO is not willing to either issue a capacity charge or commit itself to a minimum off-take (e.g. to be committed to purchase a certain amount of the generated electricity). For private investors (Personal Communication, 2017e), there is a very high risk to invest in the power sector when they are neither guaranteed a minimum off-take from TANESCO nor assured a sovereign guarantee from the government. There is excessive bureaucracy in terms of lengthy negotiation, permission, and approval processes which often discourages the investors who are willing to develop large-scale solar power projects.

Tariff cap suggested by the government. Another institutional barrier is the single-digit tariff cap suggested by the government. Deciding the utilities tariff in Tanzania has a political dimension (Personal Communication, 2017c), as the government does not want the people to suffer from a higher electricity tariff (Personal Communication, 2017a). While the interviews were conducted in Tanzania (Sep. 2017), there were news (Personal Communication, 2017e) that the Tanzanian government is intending to impose a tariff-cap at 9 US$c/kWh for all electricity generation projects to match the president’s aspiration to have a single-digit electricity tariff in the country. From TANESCO’s viewpoint (Personal Communication, 2017c), it is fair and desirable to keep the feed-in tariff paid by the utility to the power producers under the tariff which the utility can collect from the end users (political leaders are keen to keep the electricity tariff to end users –who are connected to the utility grid- at low level) (Moner-Girona et al., 2016). According to TANESCO (Personal Communication, 2017c), this issue is one of the main reasons which prevented signing any PPA with large-scale solar power investors as the feed-in tariff required by those investors is too expensive (i.e. 18 US$c/kWh or more). The only relatively large-scale solar power project recently commissioned in Tanzania (i.e. the Kigoma 5 MW solar Photovoltaic plant connected to an isolated mini-grid, commissioned late 2017) had a PPA signed in 2013 at a tariff of 18 US$c/kWh. However, currently there is a dispute between TANESCO and the developer, TANESCO argues that this tariff is outdated and has to be reviewed (Personal Communication, 2017c). According to a discussion with a high-profile manager in TANESCO (Personal Communication, 2017c), it was clearly stated that if any large-scale solar power developer is interested in signing a PPA contract with TANESCO, the tariff is expected to be in the range between 6 and 8 US$c/kWh.

Some of the private investors (Personal Communication, 2017e), development partners (Personal Communication, 2017d), and financial institutions’ representatives (Personal Communication, 2017e) see that solar power projects will not be feasible under the 9 US$c/kWh tariff cap. Some private investors (Personal Communication, 2017e) mentioned that there are inconsistent messages from the government: on one side there is a government message of imposing a strict tariff cap, on the other side the speech about promoting renewables which implicitly have higher tariffs. The private investors are confused about which message they can trust, this issue add to the uncertainty of this investment sector in Tanzania.

Political interference in the decisions of the utility and the regulator. Among the identified institutional barriers is the political interference in the decisions of the utility (TANESCO) and the regulator (EWURA). Most of the interviewed stakeholders (Personal Communication, 2017a; Personal Communication, 2017b; Personal Communication, 2017c; Personal Communication, 2017d; Personal Communication, 2017e; Personal Communication, 2017f) indicated that the Tanzanian energy sector is highly controlled by the political system. Some of the interviewed development partners (Personal Communication, 2017d) and private investors (Personal Communication, 2017e) see that EWURA is a highly professional regulator and it used to have a high level of integrity and professionalism in all its works, it is supposed to make all its decisions based on transparent techno-economic studies and assessments. Recently, the political management started interfering in EWURA’s processes and decisions, hence EWURA is not as independent now as it used to be (Personal Communication, 2017d; Personal Communication, 2017f). When EWURA proposed an electricity tariff increase, it was overruled. The tariff increase decision was stopped by the Minister of Energy and Minerals, and this action was supported by the president. Shortly after, the Director General of EWURA was dismissed (Personal Communication, 2017d; Personal Communication, 2017f; Magufuli sacks Power Company boss after raise in electricity charges, 2017). While interviewing representatives from EWURA, TANESCO, and MEM (Personal Communication, 2017c), it was noticeable that directives regarding important decisions are expected to be received from high-profile politicians. Many of the interviewed investors (Personal Communication, 2017e), development partners (Personal Communication, 2017d), and financial institutions (Personal Communication, 2017f) expressed that such political interference hinders the investment decisions in large-scale solar power projects, as it adds to the sector’s unpredictability and uncertainty risks.

Most of the interviewees from research institutions (Personal Communication, 2017a), private investors (Personal Communication, 2017e), development partners (Personal Communication, 2017d), and financial institutions (Personal Communication, 2017f) see that institutional barriers to large-scale renewables in Tanzania lead to financial and technological barriers. It is believed that when the right legislation, policy, and regulatory frameworks are in place (and followed in a transparent way), this will definitely create an enabling environment that attracts finance and technology to the sector.

Financial barriers

Off-taker non-payment risk. One of the prominent financial barrier stated by most of the interviewed stakeholders is the off-taker non-payment risk. TANESCO is the sole off-taker of any large-scale electricity generation project in Tanzania. The Tanzanian utility (TANESCO) is facing serious financial problems. According to some of interviewed development partners (Personal Communication, 2017d), there is at least USD 300 million, owed by TANESCO, outstanding to different electricity generation investors and equipment suppliers. Most of the interviewed development partners (Personal Communication, 2017d), private investors (Personal Communication, 2017e), and financial institutions’ representatives (Personal Communication, 2017f) see that the off-taker non-payment risk is key in discouraging investment in large-scale solar power projects in Tanzania. The off-taker risk in Tanzania is considered among the highest off-taker risk in Sub-Saharan Africa (Personal Communication, 2017d), such high off-taker non-payment
risk significantly affects the risk mitigation instruments considered by financial institutions. The off-taker non-payment risk is obviously reflected on the interest rates asked by lenders, which increases the cost of capital significantly, leading to a noticeable increase in the overall cost of large-scale solar power projects (Personal Communication, 2017e).

Although the off-taker risk might seem relevant for all electricity generation technologies, some of the interviewed financial institutions’ representatives (Personal Communication, 2017) believe that the off-taker risk is higher for renewable energy projects. Investors interested in large-scale solar power projects has to go for very lengthy and hard negotiation with TANESCO to reach a partial electricity purchase commitment, they are often asked to find some other additional off-grid eligible customers in rural areas (Personal Communication, 2017c; Personal Communication, 2017f). On the other hand, the large conventional projects (e.g. gas-fired) are supported by the government and the electricity purchase commitment is by default guaranteed (Personal Communication, 2017d; Personal Communication, 2017f).

Unfavourable financing conditions for large-scale solar power projects. Another financial barrier is the unfavourable financing conditions for large-scale solar power projects. Tanzanian financial institutions are not interested in financing solar power projects, especially large-scale solar power project. Some of the interviewed stakeholders from governmental institutions (Personal Communication, 2017c), development partners (Personal Communication, 2017d), and research institutions (Personal Communication, 2017a) see that interest rates and lending conditions of Tanzanian banks to solar power projects are often unfavourable, because they are considered small projects with uncertain revenue. Solar power projects (i.e. solar and wind) are often seen by local banks and financial institutions as new sophisticated technologies, linked with the intermittency of their electricity generation, hence associated with high technological risk compared to conventional electricity generation technologies (i.e. large-hydropower and gas-fired power plants). There is a high risk perception for solar power projects by Tanzanian financial institutions.

In Tanzania, government-supported energy projects (often fossil fuel-fired power plants, large-hydropower, or transmission projects) can access favourable financing conditions from the Development Finance Institutions (e.g. grants or concessional loans at 3–7% interest rate) (Personal Communication, 2017c), while private investors interested in financing solar power projects negotiate a debt interest rate in the range of 20% (Personal Communication, 2017e). Large-scale solar power projects are characterized with high upfront investment and long-term project nature. Tanzanian financial institutions are not favouring projects with high upfront investment and of long tenor. Commercial Tanzanian banks often prefer a short lending tenor, which is usually impractical for energy projects. Commercial local banks are also very sensitive to the fluctuations of the local currency exchange rate, hence they set high interest rates to account for this risk. Consequently, small and medium-sized companies interested in renewable energy projects are often discouraged.

Most of the interviewed investors (Personal Communication, 2017e) stated that the anticipated interest rate (by lenders) for large-scale solar power projects debt or equity financing is in the range of 20%. This very high interest rate is justified –by the international lenders– to account for the high risks associated with projects in Sub-Saharan Africa. In Tanzania, risks associated to large-scale solar power projects (no sovereign guarantee and no minimum off-take agreement) are higher than risks associated to conventional power projects (backed and guaranteed by the government). Such high risk perceptions increases the already high upfront investment of large-scale solar power projects further.

The unfavourable financing conditions for large-scale solar power projects (either by Tanzanian or international lenders) increase the cost of capital significantly, leading to a noticeable increase in the overall cost of the large-scale solar power projects which is reflected as a high tariff negotiated by the investors with TANESCO. From the utility side, all large-scale solar power projects’ investors are negotiating much higher PPA tariffs compared to conventional projects (e.g. gas-fired power plants) which makes large-scale solar power projects uncompetitive (Personal Communication, 2017c).

Technological barriers

Lack of data and studies to support the development of large-scale solar power projects. A study by the Joint Research Centre (JRC) of the European Commission (Belward et al., 2011) stated that: “Compared to the rest of the world, there is a general shortage of energy related information in Africa […] This lack of information is even more apparent for renewable energies […] It is indeed difficult to compare the potential for the different energy options due to the scattered validated information”. Trotter et al. (Trotter et al., 2017) reviewed electricity planning and related implementation research including more than 300 relevant peer-reviewed journal articles (considering each of the 49 Sub-Saharan African countries), the study concluded that “While robust electricity planning is widely believed to be a prerequisite for effective electrification, to date, no comprehensive overview of electricity planning research has been undertaken on sub-Saharan Africa, the world region with the lowest access rates”. One of the main technological barriers is the lack of data and studies to support the development of large-scale solar power projects. This barrier has been stated by many of the interviewed stakeholders from public institutions (Personal Communication, 2017c), private investors (Personal Communication, 2017e), research institutions (Personal Communication, 2017a), development partners (Personal Communication, 2017d), civil society organizations (Personal Communication, 2017b), and financial institutions (Personal Communication, 2017f). Two dimensions has been mentioned: (1) the lack of data and studies on solar energy resource assessment (Personal Communication, 2017e), and (2) the lack of economic and financial studies that elaborate on the estimated cost and revenue of large-scale solar power projects under the Tanzanian business environment, so potential investors can be well-informed (Personal Communication, 2017f).

Lack of qualified local personnel. Another technological barrier is the lack of qualified local personnel. According to many of the interviewed stakeholders from public institutions (Personal Communication, 2017c), research institutions (Personal Communication, 2017a), development partners (Personal Communication, 2017d), civil society organizations (Personal Communication, 2017b), there is a lack of qualified local personnel who have the capacity to design, build, and operate large-scale solar power projects at technical, business and managerial levels (Personal Communication, 2017b). According to the interviewed stakeholders from research institutions (Personal Communication, 2017a), the University of Dar es Salaam started a master’s degree in renewable energy ten years ago. So there are Tanzanian graduates who have the basic theoretical knowledge about renewable energy systems, yet they lack the practical experience and training in the field due to the lack of laboratories and training facilities, in addition to the lack of real large-scale solar power projects where the students can engage and get first-hand practical experience (Personal Communication, 2017b).

Some of the interviewed investors (Personal Communication, 2017e) and civil society organizations (Personal Communication, 2017b) mentioned that public institutions responsible for planning and decision making in the electricity sector do not have the technical capacity to evaluate and assess these projects. Some investors (Personal Communication, 2017e) stated that the regulator (EWURA) has some qualified personnel specialized at renewable energy projects, while the utility (TANESCO) is not well versed in the technological and economic dimensions of large-scale solar power projects. There is an obvious lack of technical capacity for designing and preparing business
proposals by local Tanzanian companies to meet international funders’ requirements.

**Technical limit set by the utility for electricity generation from renewables.**

Among the identified technological barriers is the technical limit set by the utility for electricity generation from renewable energy (other than large-hydropower) to be below 10% of the overall power system capacity. Some of the interviewees from the MEM and TANESCO (Personal Communication, 2017c) see that from a technical viewpoint, the electricity generation from renewable energy sources (other than large-hydropower) should be kept below 10% of the total installed capacity. Renewable energy technologies (including solar power) are seen as intermittent electricity generation technologies which cannot contribute to the power system’s base load or firm capacity. From TANESCO viewpoint (Personal Communication, 2017c), it is very difficult to integrate electricity generated from renewable energy (other than large-hydropower) into the utility grid, as renewable energy cannot contribute to the power system services (i.e. offering primary and secondary reserves) to ensure the stability of the system. There is a perception that massive and expensive electricity storage facilities are required to allow integrating more electricity from renewables in the power system.

**Discussion**

Among the identified barriers was the lack of technical capacity for designing and preparing business proposals by local Tanzanian companies to meet international funders’ requirements. Some of the interviewed foreign private investors and international financial institutions representatives (Personal Communication, 2017e; Personal Communication, 2017f) reported that there is a lack of submitted proposals from local Tanzanian companies compared to foreign companies, and the proposals submitted by local companies often do not meet the donors’ technical requirements. Consequently, international funders allocate most of their energy-related funds to foreign companies rather than to local ones. Such practice is bitterly criticized by some of the interviewed stakeholders from public institutions (Personal Communication, 2017c), research institutions (Personal Communication, 2017a), and civil society organizations (Personal Communication, 2017b) as it is seen as a way to channel the aid money to foreign companies that makes profit out of these contracts (usually it is a foreign company of the same national origin where the aid money comes from) on the expenses of stagnating skill development of local Tanzanian personnel and companies. This viewpoint consolidates the literature findings discussed in the Background section stating that significant amounts of the current development assistance for electrification in Sub-Saharan Africa are used to directly fund non-African companies (Trotter & Abdullah, 2018). Hence, our analysis consolidates the view discussed under the Background section that the foreign investment and aid directed to expanding electrification in Sub-Saharan Africa need to be reshaped (Kaijage et al., 2017; Trotter & Abdullah, 2018).

In Tanzania, although all European development partners are interested in driving an energy transition towards more renewables-based system (to reduce the dependence of the Tanzanian electricity system on fossil fuel-based technologies till 2040), they often face significant barriers to reach such objective. Due to such significant barriers, almost all European development partners and international financial institutions working in Tanzania have to direct their funding to one or another of the grid-based projects (identified as priority projects by the Tanzanian government), often transmission or distribution projects (see Fig. 2 and its related discussion in the Background section). Most of the development partners’ financial contributions to renewables-based systems are concentrated on financing and enabling small-scale RETs projects, often related to rural electrification (e.g. mini-grids, off-grid, or Solar Home System) (Kaijage et al., 2017; Personal Communication, 2017d). Hence, our analysis finds that donors (e.g. European development partners) cannot alone force an energy transition towards more renewables-based power system in Tanzania, but they can be a driving force to achieve a more sustainable energy system. This finding consolidates the findings by Marquardt et al. (Marquardt, Steinbacher, & Schreurs, 2016) who studied the role of development cooperation in promoting energy transitions in the Philippines and Morocco and concluded that: “… donators cannot force an energy transition, but can be a driving force for testing alternative ways for electricity supply through niche level experiments and regime level interventions that are closely connected to the country’s primary energy objectives”.

Most of the development partners and the international financial institutions interested in the Tanzanian energy sector are well-connected, they meet on a regular basis (i.e. monthly Energy Development Partner (EDP) meeting) to coordinate actions and to discuss the development of the energy sector in Tanzania (Personal Communication, 2017d; Personal Communication, 2017f). Development partner’s cooperation can facilitate energy transitions, whose initiation, design, implementation, and sustainability often depend on national decisions and actors. Our analysis supports building a stronger multi-stakeholder coordination among all stakeholders interested in promoting large-scale RETs in Tanzania, including stakeholders from Tanzanian research institutions, national and international private sector investors, and civil society organizations. Defining coordinated actions can be more effective than separate action(s) taken by different individual stakeholders (or stakeholder’s groups).

Under the discussed Tanzanian conditions, governmental actions are not only desirable but a must to promote large-scale solar power technologies in the country. We see the possibility to work on the compatible interests between development partners (who are pro-renewables) and the Tanzanian government (which considers expanding electrification as a political priority). As discussed earlier, most of the investment in the Tanzanian energy sector is led by international financial institutions (often driven by development partners). There is a need to develop a new approach to support sustainable energy transition in Tanzania. For instance, development partners can support (technically and financially) developing a pilot large-scale solar power project(s) to underline a viable alternative to the fossil fuels-based business as usual scenario.

It is essential to communicate how development partners’ interest in large-scale RETs is compatible with the Tanzanian government’s interest of expanding electrification, especially to population (and load centres) at the centre and north of Tanzania (which are located far away from the existing and the planned fossil-fuel power plants, and not well-connected to the utility grid yet – see Fig. 2). Integrating large-scale renewables in the Tanzania electricity sector will also help the Tanzanian government to achieve its climate commitment. Identifying and communicating such compatible interests between development partners and the Tanzanian government will help greatly in overcoming most of the identified institutional barriers which can be linked to the government’s disinterest in large-scale solar power (and other large-scale renewables, expect large-hydropower). So if the development partners succeed to make the Tanzanian government interested in large-scale solar power (and other large-scale renewables), this will lead to overcoming (partially or totally) most of the institutional barriers facing the deployment of large-scale solar power in Tanzania. The involvement of the public sector stakeholders including actors at all levels of the Tanzanian government (e.g. MEM, TANESCO, REA, EWURA and the Vice President’s Office for Environment) is crucial for achieving sustainable energy transition in Tanzania. Development partners and international financial institutions can play an important role through financing (incl. Results-Based Financing (RBF) (Economics, 2013)), technology transfer, training, and technical assistance. The longstanding relationships between development partners and energy-related Tanzanian public/governmental institutions (Personal Communications, 2016; Personal Communication, 2017c; Personal Communication, 2017d; Personal Communication, 2017f)
can create trust and allow fruitful discussion, coordination, and collaboration.

One of the identified technological barriers was the technical limit set by the utility for electricity generation from renewable energy (other than large-hydropower) to be below 10% of the overall power system capacity. Renewable energy technologies are seen by the utility (and other public institutions) as intermittent and unreliable electricity generation technologies which cannot contribute to the power system's base load or firm capacity. Indeed there are some renewable energy technologies which are non-intermittent and which can contribute to the power system's firm capacity, like the Concentrated Solar Power technologies with thermal storage (Aly et al., 2017; Aly et al., 2018; Zhang et al., 2013; Ziuku et al., 2014; Sharma et al., 2018). A recent study (Aly et al., 2017) estimated that in Tanzania there is 3584 km² of area which is most suitable for Concentrated Solar Power installations. Regarding solar Photovoltaics and wind energy, it is worth mentioning that the Royal Norwegian Embassy in Tanzania contracted Norconsult AS in 2015 to conduct Power System Stability Study to investigate the impact of connecting solar Photovoltaic and wind power plants to the Tanzanian utility grid (Personal Communication, 2017d). The final report (Connection of wind and solar power plants to the main grid in Tanzania: Power system stability study, 2016) was published in 2016, the study concluded that the technical limits for the overall intermittent renewables capacity is about 385 MW in the short term (at 1250 MW peak demand), and about 710 MW in the medium term (at 2500 MW peak demand). From an economic viewpoint, large-scale solar power projects (incl. Concentrated Solar Power (Aly et al., 2018)) can replace the most expensive generation units which sells electricity to TANESCO at 31–40 USc/kWh (Eberhard et al., 2016).

Conclusions

The study used a stakeholder-based approach to answer the question “What are the barriers to large-scale solar power in Tanzania?”: Qualitative research was conducted, and primary data was collected through 30 semi-structured interviews with the main electricity sector’s stakeholders. The study elaborated on the perceptual agreements and differences among the stakeholders about the barriers to the deployment of large-scale solar power in Tanzania. Our analysis demonstrated that barriers to large-scale renewables in Tanzania can be clustered into three main groups: institutional barriers, financial barriers, and technological barriers. The study revealed that in Tanzania the institutional barriers for the diffusion of renewable energy technologies are predominant, and they usually trigger financial and technological barriers. The prioritized list of institutional barriers was identified as follows: the uncertainty around the government commitment towards large-scale solar power projects; the decision makers’ perception that solar power technologies cannot be used for large-scale generation; the discouraging business environment for the private investors interested in large-scale solar power projects; the single-digit tariff cap suggested by the government; and the political interference in the decisions of the utility and the regulator. The prioritized list of financial barriers was identified as follows: the off-taker non-payment risk and the unfavourable financing conditions for large-scale solar power projects. The prioritized list of technological barriers was identified as follows: the lack of data and studies to support large-scale solar power projects; the lack of qualified local personnel; and the technical limit set by the utility for electricity generation from renewable energy (other than large-hydropower).

Although there are challenges and barriers for integrating large-scale renewables in the Tanzanian power system, there are also some obvious opportunities as: (1) expanding electrification is a political priority in the country, (2) all the interviewed European development partners (including the Delegation of the European Union to Tanzania) are pro-renewables, and (3) all large-scale power projects are mostly financed by international financial institutions. The study argues for the possibility to work on the compatible interests between development partners (who are pro-renewables) and the government (which considers expanding electrification as a political priority) through considering large-scale renewable energy projects that can help in expanding electrification while being technically and financially supported by development partners (especially European ones). Working on overcoming the identified barriers to the deployment of large-scale renewables in Sub-Saharan Africa will contribute to ensuring access to affordable, reliable, sustainable, and modern energy for all.

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Appendix A. List of conducted interviews in Tanzania, Sep. 2017

| Cluster                      | Organization                                                                 | Interview number |
|------------------------------|-----------------------------------------------------------------------------|------------------|
| Public/governmental          | TANESCO, investment department                                              | 1                |
| institutions                 | TANESCO, training department                                                 | 2                |
|                              | TANESCO, research department                                                 | 3                |
|                              | TANESCO, transmission department                                             | 4                |
|                              | Ministry of Energy and Minerals (MEM)                                        | 5                |
|                              | Ministry of Energy and Minerals (MEM), renewable energy division             | 6                |
|                              | Energy and Water Utilities Regulatory Authority (EWURA)                      |                  |
|                              | Rural Energy Agency (REA)                                                    | 8                |
|                              | Department of Environment                                                    | 9                |
| Research institutions        | University of Dar es Salaam (UDSM)                                          | 10               |
|                              | Tanzania Commission for Science and Technology (COSTECH)                    | 11               |
| Private investors            | Envirotech Verda Africa Ltd.                                                 | 12               |
|                              | Frontier Investment Management                                              | 13               |
|                              | Windlab                                                                     | 14               |
| Civil Society Organizations  | Tanzania Renewable Energy Association (TAREA)                               | 15               |
|                              | Tanzania Traditional Energy Development and Environment Organization (TaTEDO) | 16               |
|                              | World Wildlife Fund (WWF)                                                    | 17               |
|                              | Tanzania Youth Coalition (TYC)                                               | 18               |
|                              | Climate Action Network (CAN)                                                 | 19               |
| Development partners         | Danish International Development Agency (DANIDA)                            | 20               |
|                              | Norwegian Agency for Development (Norad)                                     | 21               |
|                              | Cooperation (Norad)                                                         |                  |
|                              | Swedish International Development Cooperation Agency (Sida)                  | 22               |
|                              | Delegation of the European Union to Tanzania (USAIID)                       | 23               |
|                              | Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH           | 24               |
|                              | Agence Française de Développement (AFD)                                     | 25               |
|                              | Japan International Cooperation Agency (JICA)                                | 27               |
| Financial institutions       | The African Development Bank (AFDB)                                         | 28               |
|                              | The German Development Bank (GDB)                                           | 29               |
|                              | The Export-Import Bank of Korea (Korea Eximbank)                            | 30               |

References

AfDB and Government of Japan launch Japan-Africa Energy Initiative (2017). Retrieved from https://www.afdb.org/en/news-and-events/afdb-and-government-of-japan-launch-japan-africa-energy-initiative-17154/ (15.03.2018; 04.07.2017).

Africa Clean Energy Corridor (2014). Retrieved from http://www.irena.org/clea
ergycorridors/Africa-Clean-Energy-Corridor (19 Apr. 2018).

A. Aly et al. / Energy for Sustainable Development 48 (2019) 43–58

57
Nearly 50 countries vow to use 100% renewable energy by 2050. Retrieved from

Guion, L. (2002). The political economy of grand corruption in Tanzania. Journal of Contemporary Management, 6(1), 229–240.

Jacob, T. (2017). Competing energy narratives in Tanzania: Towards the political economy of coal. African Affairs, 116(463), 341–353.

Kajange, E., Shikuru, N., Best, Sarah, Cosmas, Remigij, Temba, Suzan, Mtwanga, Benjamin, & Mwita, N. (2017). Money is power: Tracking finance flows for decarbonisation efforts in Tanzania. London: IDEAS.

Lidula, N., et al. (2007). ASEAN towards clean and sustainable energy: Potentials, utilisation and barriers. Renewable Energy, 32(9), 1441–1452.

Magufuli Sacks Power Company boss raise in electricity charges. Retrieved from https://naiborunews.nation.co.ke/news/magufuli-sacks-power-company-boss-raise-in-electricity-charges/(2017). 09/08/2018.

Malimbwi, R. E., & Zabahu, E. (2008). The analysis of sustainable fuelwood production systems in Tanzania. Tanzania’s new natural resources legal framework – What will change? Dar es Salaam: The Natural Resource Governance Institute.

McCormick, K., & Käberger, T. (2007). Key barriers for bioenergy in Europe: Economic conditions, know-how and institutional capacity, and supply chain co-ordination. Biomass and Bioenergy, 31(7), 443–452.

Mikolaj, E. (2005). Methods for development work and research: A new guide for practitioners. Sage.

Mnjokava, T. T., Kabaka, K., & Mayalla, J. (2015). Geothermal development in Tanzania – A country update. World geothermal congress 2015 (pp. 2015). Melbourne, Australia: World Geothermal Congress.

Moner-Girona, M., et al. (2016). Adaptation of feed-in tariff for remote mini-grids: Tanzania as an illustrative case. Renewable and Sustainable Energy Reviews, 53, 306–318.

Mwiti, L. (2015). How will Africa adapt to green energy? Geneva: World Economic Forum. National power development projects-1 (2016): 17-2020/1/2016. Dar es Salaam: Ministry of Finance and Planning, the United Republic of Tanzania.

Natural Gas Utilization Master Plan 2016–2045 (NGUMP) (2017). Dar es Salaam: Ministry of Energy and Minerals, the United Republic of Tanzania.

Nesamaharaj, J. D. J., Venkatesh, P., & Scourfield, R. C. (2017). The drive of renewable energy in Tamilnadu: Status, barriers and future prospect. Renewable and Sustainable Energy Reviews, 73, 115–124.

New and Ongoing Power Projects (2018). Retrieved from http://www.tanzesco.co.tz/index.php/power-projects-donor-funded-projects-1 (10/08/2018).

Ohunakin, O. S., et al. (2014). Solar energy applications and development in Nigeria: drivers and barriers. Renewable and Sustainable Energy Reviews, 32, 294–301.

Paimuly, J. P. (2001). Barriers to renewable energy penetration; a framework for analysis. Renewable Energy, 24(1), 73–89.

Personal Communication (semi-structured interviews) with representatives from Research Institutions (see Appendix). 2017a.

Personal Communication (semi-structured interviews) with representatives from Civil Society Organizations (see Appendix). 2017b.

Personal Communication (semi-structured interviews) with representatives from Public Governmental Institutions (see Appendix). 2017c.

Personal Communication (semi-structured interviews) with representatives from Development Partners (see Appendix). 2017d.

Personal Communication (semi-structured interviews) with representatives from Private Investors (see Appendix). 2017e.

Personal Communication (semi-structured interviews) with representatives from Financial Institutions (see Appendix). 2017f.

Personal Communications through 27 consultation sessions conducted in the summer of 2016 with representatives from governmental institutions, research institutions, private sector, local and international NGOs, and development partners. 2016.

Peter, C., & Sander, K. (2000). Environmental crisis or sustainable development opportunity? Transforming the charcoal sector in Tanzania: A policy note. Washington, DC: The World Bank.

Powell System Master Plan, 2016 update (2016). Dar es Salaam: Ministry of Energy and Minerals, the United Republic of Tanzania.

Prell, C., et al. (2007). If you have a hammer everything looks like a nail: traditional versus participatory model building. Interdisciplinary Science Reviews, 32(3), 263–282.

Prell, C., et al. (2016). Mapping of Energy Initiatives and Programs in Africa. Germany: Eschborn.

Reddy, S., & Painly, J. P. (2004). Diffusion of renewable energy technologies—Barriers and stakeholders’ perspectives. Renewable Energy, 29(9), 1431–1447.

Reed, M. S., et al. (2009). Who’s in and why? A typology of stakeholder analysis methods for natural resource management. Journal of Environmental Management, 90(5), 1933–1949.

Sanlanty, D., Schlotterer, R., & Eberhard, A. (2014). Harnessing African natural gas: A new opportunity for Africa’s energy agenda? (Washington, DC: The World Bank).

Sharma, C., et al. (2018). Cost reduction potential of parabolic trough based concentrating solar power plants in India. Energy for Sustainable Development, 42, 121–128.

Sovalod, B. K. (2009). Reducing renewables: the socio-technical impediments to renewable energy technologies in the United States. Energy Policy, 37(11), 4500–4513.

Tagliapietra, S., & Bazilian, M. (2017). The role of international institutions in fostering sub-Saharan Africa’s electrification. Tanzania’s SE4ALL action agenda (2015). Dar es Salaam, Tanzania: Ministry of Energy and Minerals, the United Republic of Tanzania.

The Sustainable Development Agenda. Retrieved from https://www.un.org/sustainabledevelopment/sustainabledevelopment-agenda/(2016). 26/06/2018.

Transforming our world: the 2030 Agenda for Sustainable Development (2015). United Nations General Assembly (Resolution adopted by the General Assembly on 25 September 2015).

Trotter, P. A., & Abdullah, S. (2018). Re-focusing foreign involvement in sub-Saharan Africa’s power sector on sustainable development. Energy for Sustainable Development, 44, 139–146.

Trotter, P. A., McNamara, M. C., & Macanachie, R. (2017). Electricity planning and implementation in sub-Saharan Africa: A systematic review. Renewable and Sustainable Energy Reviews, 74, 1189–1205.

UN Framework Convention on Climate Change (UNFCCC) (2015). Tanzania submits its climate action plan ahead of 2015 Paris agreement. Retrieved from http://newsroom.unfcc.int/unfccc-newsroom/tanzania-submits-its-climate-action-plan-ahead-of-2015-paris-agreement/(14 Aug. 2017).

UN Framework Convention on Climate Change (UNFCCC) (2017). The Paris agreement. Retrieved from http://unfccc.int/paris_agreement/items/9485.php (14 Aug. 2017).

Whitfield, L., et al. (2015). The politics of African industrial policy: A comparative perspective. Cambridge University Press.