

De-risking solar auctions in sub-Saharan Africa – A comparison of site selection strategies in South Africa and Zambia

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Abstract

While competitive auctions are becoming increasingly popular for tendering renewable energy projects to private plant developers in Africa, their specific project risk implications are not yet well understood. This paper identifies project risks arising from two types of auction schemes. It compares an approach where the government pre-selects the sites for future renewable energy plants in Zambia's Scaling Solar initiative to one where project developers choose, secure and conduct due diligence on their sites before bidding in South Africa's Africa's Renewable Energy Independent Power Producers Procurement Programme (REI4P). Semi-structured interviews with developers who have participated in both schemes reveal notably different risk profiles. Despite contrary intentions, site-specific risks have been perceived as the highest overall project risk in the government-led site selection in Zambia. Specifically, site-specific risks were driven by several severe technical issues such as geotechnical, grid connection and solar irradiation uncertainties. By contrast, in South Africa's developer-led site selection, site-specific risks have been perceived to be important, but less pronounced, and more evenly distributed among technical, economic, legal, permitting and social factors. This paper recommends auction design which minimise project risks for all stakeholders. Where governments pre-select sites, closely consulting the private sector is advisable prior to bidding to identify and mitigate technical and other site-specific risks.

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Keywords

Renewable energy procurement; Competitive tendering; Energy governance; Investment risks; Sustainable development

1. Introduction

Recent years have seen the beginnings of a global transition towards renewable energy-based power systems, with the majority of investments in the power sector since 2015 being directed at renewables [1]. Developing countries particularly are becoming a key focus for renewable energy investments. To tender utility-scale renewable energy projects, competitive procurement schemes or auctions have rapidly spread [2], currently being applied in at least 65 countries worldwide [1]. This trend is salient in sub-Saharan Africa (SSA) in the last five years. Following South Africa's Renewable Energy Independent Power Producers Procurement Programme (REI4P), with its first auction in 2011, there are now at least 11 countries in SSA that have either started or completed competitive renewable energy project procurement, including Zambia, Uganda, Ghana, Namibia, Malawi, and Ethiopia. Competitive procurement is being rolled out in several further countries in the near future. The majority of these tenders focus on utility-scale solar photovoltaic (PV) plants, between 5MW and 100MW in size [3–10].

While the growing usage of auctions for solar PV projects is driven by their capability to attract low-cost bids from a variety of international project developers, they imply different specific risks. This paper analyses the risks associated with auction processes which differ in how the project site is selected, widely seen as a crucial element for the successful operation of a solar PV plant [2,11–13]. For the implementation of large-scale solar PV projects, two different strategies for site selection can be distinguished. The first is government-led, i.e. where a governmental agency or state-owned utility selects a potential

site prior to inviting private companies to bid on the project. The second is a developer-led strategy for site selection, where private companies select their own sites on which they want to develop their energy project before submitting a bid in an auction.

Both strategies have recently been applied in SSA. In South Africa's REI4P and Uganda's GET FiT Solar Facility, developers have selected and prepared² their project sites [14,15]. Government-led site selection, however, is the dominant strategy in Africa, applied in countries such as Namibia, Ethiopia, Malawi, Ghana and Zambia's Scaling Solar initiative [7,16–18]. Arguments for government-led site selection have included the potential of speeding up project development and reducing project risks through governmental procuring authorities securing land access, providing geotechnical data, securing integration with the national grid, and obtaining general permits before the auctions take place. Quicker project development through lower risks imply a lower cost of capital, which enables lower bid prices [13,19,20]. However, contrasting recent auctions experiences of two prominent African cases, namely Scaling Solar in Zambia and REI4P in South Africa, raise questions about these arguments. Both of the Scaling Solar PV projects with government-led site selection have been significantly delayed, with one of the winning bidders explicitly stating that the private sector would have been better placed to select the sites [21]. In contrast, over 95% of the renewable energy projects from the first three rounds of South Africa's developer-led REI4P were delivered on time [14,22].

To the best of our knowledge, this paper is the first to empirically analyse and compare government-led versus developer-led site selection approaches in renewable energy project auctions. Drawing from semi-structured interviews with solar PV development companies that have participated in both the Scaling Solar and REI4P auctions, this paper makes two novel contributions to the literature. Firstly, we find different perceived general risk patterns for the two site-selection approaches. Site-specific risks were named as the most important

² In this context, site preparation refers to the administrative, analytical and acquisition processes involved in getting a site ready for a project before construction can begin. Most of these processes occur prior to financial close being reached on a project. Depending on the programme, bidders may need to have completed parts of site preparation prior to bidding.

and dominant risk where the government had chosen the site in Scaling Solar. In REI4P, where site selection has been developer-led, site-specific risks, while still salient, are perceived to be less important. These results further question the common assumption that a pre-selection of sites by the government reduces site risks for developers. Secondly, studying the different types of perceived site selection risks by the developers reveals that several crucial technical risks, as well as legal risks surrounding land ownership, have been especially severe in Scaling Solar, despite the Zambian government's initial motivation to reduce these risks by pre-selecting sites. In REI4P, site-specific risks were less pronounced and more spread between different technical, economic, legal, permitting and social issues. Especially given the Zambian government's failure to provide sufficient detail to fully assess the sites' geotechnical risks, seen as a significant challenge for successful project implementation, we recommend that developers should be involved in the site selection before the auction takes place to utilise their expertise and jointly reduce project risks. The prominence of government-led site selection processes in sub-Saharan renewable energy auction programs, as well as the fact that most of these programs are still in their infancy, warrant an improved rollout of renewable energy procurement in the region.

The paper is structured as follows. Section 2 explains solar PV project site selection processes in general and discusses the central features of the paper's two case studies, namely REI4P in South Africa in comparison to Scaling Solar in Zambia. Research methods details regarding the semi-structured interviews and the analytical framework used to analyse the responses are presented in section 3. Section 4 discusses the results, while a conclusion and policy implications are offered in section 5.

2. Background

2.1. Renewable energy site selection

Site selection issues have gained considerable attention in the literature on renewable energy development in industrialized countries and, to a lesser extent, in developing countries [11,23]. Thematically, the site selection literature can be grouped into three stains. Firstly, the majority of studies is concerned with the technological optimisation of renewable energy resource utilisation [24–30], oftentimes through the use of multi-criteria decision support models [31–39].

Secondly, a related body of literature is concerned with understanding and estimating the site-specific environmental and social impacts of renewable energy plants [40–46]. There is a recently growing interest in renewable energy-related land politics, land grabbing and social conflict as these technologies penetrate developing country markets [15,47,48].

A third and yet smaller cluster of literature, most closely related to this paper, discusses site selection issues as risks for renewable energy projects, most often through the lens of potential investors and project developers [11,49–54]. Kahn (2000: 22) claims that “[s]ite location has more to do with a renewable energy project’s ultimate success or failure than any other single factor”. Site-specific risks identified in the literature include renewable energy resources, permitting (environment, social, planning), land acquisition or leasing, grid access and administrative capacity. In terms of Africa-focused studies, Barry et al., (2011) find that site selection is a key success factor for renewable energy pilot projects in the region, specifically emphasising community acceptance as a core issue. A systematic review of electricity planning and implementation literature focused on SSA by Trotter et al., (2017) finds that land access is listed by 30 articles as an electrification delivery success factor, including for renewable energy investments. While the academic literature has not focused on different site-selection process designs, the World Bank’s International Finance Corporation (IFC) has suggested that an optimal site selection process is crucial for the success or failure of a renewable energy project [12]. The following subsections discuss the

two cases this paper focuses on - Scaling Solar in Zambia and REI4P in South Africa - in terms of their different setup and site selection approaches, respectively.

2.2. Government-led site selection: The Scaling Solar case in Zambia

Scaling Solar was developed by the International Finance Corporation (IFC), a member of the World Bank Group, as a “one stop shop” package to support the implementation of grid-connected solar PV projects across Africa. It comprises advisory services, standardised (bankable) contracts and documentation, and offers stapled financing, guarantees and insurance [19]. Scaling Solar was launched in Zambia in 2015 following a directive by Zambia’s president Edgar Lungu to the Industrial Development Corporation (IDC), a Zambian state-owned enterprise (SOE), to install 600 MW of solar PV capacity. This directive was part of the government’s response to a severe electricity supply crisis, caused primarily by prolonged periods of drought affecting the largely hydro-based power system³. The IDC entered into an agreement with the IFC to implement the Scaling Solar programme for the procurement of this capacity [56,57]. A prequalification round was launched in October 2015 for two 34 - 55 MW plants. Forty-eight bidders submitted expressions of interest and 11 were prequalified. Bids were evaluated solely on price, and the two winning bidders were announced in June 2016: Neon/First Solar with 52MW (US\$c 6.02/kWh) and ENEL Green Power with 34MW (US\$c 7.84/kWh). At the time of their announcement, these non-indexed tariffs were some of the lowest for utility-scale solar PV in the world, made all the more significant by Zambia’s sub-investment grade credit rating and the considerable solvency problems of the state-owned utility company ZESCO (Zambia Electricity Supply Corporation) which functioned as the offtaker for the Power Purchase Agreements (PPAs) [58–60]. The IDC, which formally owns ZESCO, and the developers who were awarded the

³ In 2016, the installed capacity from Zesco and Independent Power Producers (IPPs) in Zambia amounted 2,827MW. The largest share of the installed capacity was hydro power (2,388MW or 84.5%) [68].

project act as shareholders of special purpose vehicles (SPVs) that own and operate the PV plants.

In terms of site selection, Scaling Solar's approach was entirely driven by the Zambian government through its SOEs, with the support of IFC advisors. The land for the two sites in the Lusaka South Multi-Facility Economic Zone was allocated by the Zambian Development Agency (ZDA) and leased by the IDC. The IDC led the permitting and site inspection process. It provided site climatic studies, environmental and social impact reports through independent contractors, grid interconnection information, as well as site and legal due diligence reports to bidders. The IDC (through ZESCO) is also responsible for providing the sub-station and transmission infrastructure to the site for evacuation of the power. Environmental and social impact reports of the site showed that there are several potential problem areas, including geotechnical risks and illegal land occupation, but the government's description lacked the necessary detail to enable developers to carefully assess and price these risks [61].

The main reasons to use a government-led site selection approach in Zambia included the limited number of projects, the political urgency due to the energy crisis and largely unregulated land-ownership conditions in the country. Stated goals of the site selection and preparation process were to enhance general interest and competition amongst potential bidders in a nascent market; to mitigate the risk of programme failure; to minimize or avoid the cost of land acquisition and securing long-term land-title agreements; to facilitate comparability of the bids, and to shorten the overall timeline of project implementation. Despite achieving low tariffs during the first bidding round and a comparatively short timeline from project announcement to project award, the projects of round one currently face a significant delay. The official timeline issued by IDC for awarded projects to reach financial close was six months after the award date in May 2016. Only in December 2017, financial close of the 52MW project awarded to Neon was confirmed, while financial close of the second project awarded to Enel Green Power is only expected later in 2018 [56,62].

2.3. Developer-led site selection: The REI4P case in South Africa

The South African REI4P programme was initiated in 2011, after the country switched from feed-in tariffs to a competitive tendering scheme for renewable energy. Since then there have been five rounds of competitive procurement of renewable energy projects. As of 2017, 102 projects worth more than 6,328 MW of renewable capacity have been awarded. The majority of the energy generation projects are either solar PV or onshore wind, although there were also auction allocations for biogas, biomass, small hydro and concentrated solar power (CSP). The program has attracted significant international attention, with more than 390 bids submitted over 5 rounds (2011 – 2015), and competition dramatically driving prices down to levels below the national electricity utility, Eskom's, average cost of supply [14]. The solar PV projects were constrained to a maximum project size of 75 MW, and most projects are at or very close to this limit. During the first auction round, less than half of the total auctioned volume (3,626 MW) was awarded. 1,450 MW of this volume was reserved for solar PV, but only 627 MW was awarded. The second round awarded 1,040 MW in total and 417 MW for solar PV, with similar capacity levels awarded in subsequent rounds. By March 2017, 56 of the contracted projects had completed construction and moved into operation; a further nine projects are currently under construction.⁴ Over 95% of the projects awarded in REI4P's first three rounds have managed to achieve financial close and commercial operation within the planned timeframe [63].

With regards to its developer-led site selection approach, compliance criteria and bidding requirements in REI4P have been stringent. In contrast to Scaling Solar, developers have been solely responsible for the selection, preparation and securing of the project site [14,64]. These included choosing potential sites, measuring renewable energy resources where such data were not available, assessing technical and non-technical risks, securing land

⁴ The remaining 51 projects were held up by Eskom's refusal to sign their power purchase agreements, despite the being the official offtaker of power for the procurement programme.

ownership, and ensuring the connection to the national grid by agreeing with national utility Eskom which transmission substation the new plant could be connected to. The developers needed to prove the fulfilment of site-related duties by presenting finalised contracts (explicitly including land rights), permits as well as financial and non-financial site-related agreements in place prior to bidding. They were initially required to have either a lease agreement for the entire life of the project (20+ years), or a land title submitted as part of the bid. Later rounds saw bidders having the option of submitting a land option agreement as part of their bid in an attempt at lowering some of the bidding costs associated with the program.

3. Methodology

Although the size of both initiatives differs, comparing Scaling Solar's government-led site selection approach with REI4P's developer-led strategy constitutes an intriguing vehicle to study associated risk patterns. Of the at least 11 renewable energy auction programs in SSA, only three have seen projects reach financial close: REI4P in South Africa; GET FiT's solar facility in Uganda; and Scaling Solar in Zambia. REI4P is the biggest and most advanced developer-led renewable energy auction program in SSA. Scaling Solar in Zambia is the furthest advanced government-led program in SSA, and the only one in which at least one project has managed to reach financial close. Several project developers have participated in the auction schemes of both programmes, possessing key insights of the different risk implications of both processes.

Semi-structured interviews were conducted over a three-month period between Nov 2017 – Jan 2018 with six solar PV project developers and investors⁵ that have significant experience in auctions with both government-led and developer-led site selection strategies. All six developers interviewed for this paper participated in Scaling Solar Round 1 in Zambia,

⁵ The respondents requested to remain anonymous due to their current active engagement .

all belonging to the group of 11 bidders that passed the pre-qualification stage for this round. Four of these developers had also taken part in South Africa's REI4P. The remaining two have had experience with other developer-led processes in developing countries. Interviews were structured to elicit responses on general as well as site-specific risk assessments in both types of programmes. Respondents were asked to identify, explain and rank the top (maximum five) general project development risks for both types of processes – with the intention of identifying the relative importance of site-related risks within a broader set of project risks. Respondents were similarly asked to identify, explain and rank the top (maximum five) site-related risks for both a government-led and developer-led solar PV bidding process. Questions were framed in an open-ended fashion, and responses categorised according to thematic clusters after the interviews. Respondents were further asked to explicitly state whether site-related risks were of more concern in the government-led or developer-led processes. They were also asked to provide reasons for the differences (if any) in the site-related risks between both types of processes, and to provide recommendations for possibly addressing some of these concerns.

Based on an empirical analysis in cooperation with a Spanish project developer, Aragonés-Beltrán et.al. (2010) presented 50 different project delay and stoppage risks for the processes of solar PV site-selection and project implementation. These single risks have been subsumed by Aragonés-Beltrán et.al. under the following six categories: political risks, technical risks, economic risks, permitting⁶ risks, legal risks and social risks (Aragonés-Beltrán et.al., 2010). This paper uses these categories to categorise and analyse the responses by developers. The results are also compared across both site selection processes, as well as with the expected results based on renewable energy auction design literature.

⁶ The original title for this category in Aragonés-Beltrán et al's (2010) classification is "time delay risks". Given that the majority of the risks in this category deals with permitting and approval processes, we have changed the name to "permitting" for greater clarity.

4. Results and discussion

Results are presented by first interrogating general project development risks for both types of solar PV site selection processes, government-led vs. developer led (section 4.1). We then analyse the site-selection specific risks mentioned for both programmes (section 4.2) through using the six risk categories presented by Aragonés Beltrán et al. (2010), and explore some of the potential impacts. Finally, we provide and discuss the respondents' recommendations for improving the site selection process (section 4.3).

4.1. General project risks

In terms of overall project risk perceptions for the two programmes, the interviewed developers identified salient differences in risk patterns and priorities (**Error! Reference source not found.**).

[Fig 1]

In the government-led *Zambian* case, site-related risks are the most pressing concern for most developers. Issues such as geotechnical problems with the site, as well as uncertainty regarding the ownership of the site were not only mentioned frequently, but were also mentioned first by most respondents. This was further borne out when developers were asked whether they are more concerned with site risks in *Scaling Solar*, or in the *REI4P*: the majority of respondents indicated that while the provision of the site in *Scaling Solar* “levels the playing field”, it also introduced significant and potentially severe risks to the project development process. As a result, developers were considerably more concerned with site-related risks in the *Zambian* programme than in the *South African* one.

The *Zambian* electricity regulatory framework introduced a number of further uncertainties to the process – specifically the fact that the current grid code requirements are not aligned with solar PV technologies, requiring “black-start” capabilities at all times of the day. Respondents mentioned that project closure has therefore been further delayed to allow for

a revision of the applicable regulations. There is also seemingly limited transparency with regards to the process of and timelines for the granting of generation licenses to projects. Further project development risks mentioned for Scaling Solar included: the mismatch between the currency of the PPAs (US dollars) and the currency of the electricity tariffs (Zambian Kwacha); the actual availability of foreign currency in the country; and the creditworthiness of the off-taker (ZESCO).

By contrast, most interviewed developers were less concerned with site-specific risks where site selection was performed by themselves in South Africa's REI4P. Rather, they identified political and processual risks as most pressing. The off-taker – national utility Eskom – had refused to sign PPA's of projects in the 2015 REI4P round, creating a policy and political impasse that seemed likely to derail the entire procurement programme. This power imbalance between bidders and the off-taker – a very large monopoly incumbent - created further uncertainty about grid access, and the related costs.

Permitting and other licensing requirements were also mentioned as project development risks for REI4P, and while these are traditionally considered to be site-related risks, in this particular context the concern was more due to the fact the delays in the signing of the PPA's would mean that many of these approvals would lapse, opening up project bids to potential additional unforeseen costs. This same concern was raised regarding some of the land agreements: landowners might be unwilling to extend existing agreements based on the delays and uncertainty in the programme. Further project development risks mentioned for REI4P include currency depreciation (the PPAs of REI4P are denominated in South African Rand); a shortage of relevant technical Operations and Maintenance skills (O&M); and the potential of poor technical performance of the PV plant itself.

4.2. Site selection specific risks

Error! Reference source not found. provides a visual summary of the site-specific risk categories identified by developers for the two different types of project site selection

processes. While *technical* risks are important for both processes, risks in this category make up a larger part of the site-specific risk profile in a government-led process than for a developer-led process. *Permitting* risks also receive significant attention in a developer-led process. While a developer-led process also seems to introduce *economic* and *social* risks to the process (perhaps unique to the South African programme due to the specific socio-economic development requirements in the procurement documentation), it is perhaps not surprising to note that *political* risk related to the site is a concern in a government-led process.

[Fig. 2]

The apparent differences in risk categories for the two types of site selection processes need to be further unpacked to provide useful insight into the reasons for the different risk patterns. Below we therefore discuss the elements that make up these categories in more detail. **Error! Reference source not found.** provides a list of the specific risks identified by the interviewees for each category. Each risk will be discussed and defined in the context of the interview responses in the following sub-section.

[Table 1]

Error! Reference source not found. breaks down **Error! Reference source not found.** into specific risks as indicated in **Error! Reference source not found.**, showing how often a specific risk was mentioned for the two types of site-selection processes (government-led on the left-hand side vs. developer-led on the right-hand side). It suggests that the quantum of perceived risks for a developer-led process is greater than for a government-led process; conversely, a government-led process shows a higher concentration in a handful of prominent risks.

[Fig. 3]

Geotechnical risks (Tech.1) – while being a prominent risk for both processes – dominates the perceived risks for the government-led process. Grid connection (Tech.2) is an important

risk for both processes (more prominent in a government-led process), as well as land ownership agreements (Leg.1). Environmental and other permitting (Perm.1) is the most frequently mentioned risk in a developer-led process.

Error! Reference source not found. compares the number 1 ranking of perceived risks for both type of process. It shows a picture similar to that of **Error! Reference source not found.**: a concentration of site-related risk in one particular area (geotechnical risk) for the government-led process, as opposed to a wider variety of site-related risks for a developer-led process.

[Fig. 4]

In the following section, each risk is discussed in the context of its corresponding risk category according to the responses from the interviewed project developers.

4.2.1. Technical risks

The technical risk category appears to be the most important in terms of site-related risks. More than eight distinct “technical” risks were identified, most of which were highly ranked – more so for government-led processes than for developer-led ones.

The most frequently identified and highest ranked technical risk for the Scaling Solar program was the geotechnical (Tech.1), or sub-soil problems with the selected sites: sinkholes are apparently pocketed throughout the sites provided by the ZDA, requiring significant additional site preparation work. Respondents reported that the full extent of these problems were not known at the time of bidding, and that bidders had therefore failed to adequately price in the costs for remedying the situation. One of the respondents concluded that, given the intense competition in the program that resulted in very low prices with thin margins, this omission has the potential to become a fatal flaw for a project. Geotechnical risks were also mentioned by three developers for a developer-led site selection processes,

yet it is not highly ranked and is an issue that would have been fully scoped and costed prior to bidding in this type of process.

The second most prominent technical risk is grid connection (Tech.2), identified by three developers for the government-led process in Zambia, and two developers for the developer-led process in South Africa. This risk refers to the physical infrastructure required to connect the project to the grid, and the possible barriers (technical, physical) involved in ensuring that this connection is in place on time. In South Africa, developers were responsible for connecting their PV power plants to the closest sub-station – often meaning that power lines had to be built over many kilometres. It also meant that, where grid strengthening was needed, the project would be dependent on the grid provider (Eskom) to complete this work on time. In general, projects are responsible for the costs of “shallow” connection works, while Eskom is responsible for carrying out and paying for “deep” connection works. Bidders are responsible for submitting a “Cost Estimate Letter” from Eskom as part of their bid, indicating the potential cost of connecting the proposed renewable energy plant (for the bidder’s account). This letter has to be replaced by an accurate and up-to-date “Budget Quote” once the bidder has advanced to “preferred bidder” status. The discrepancies between the “letters” and “quotes” can be considerable, with many bidders complaining of cost escalations many times the original quoted price. This is a risk entirely borne by the bidder, and therefore exposes bidders to considerable financial risk. In the government-led process in Zambia, the projects were completely dependent on ZESCO for building the power line and sub-station on time. This point of interconnection between the project and the off-taker/grid-provider is therefore an important area of uncertainty and risk for developers.

Effective estimation of solar irradiation (Tech.3) was mentioned for both programmes, but as is clear from **Error! Reference source not found.**, it is a more prominent risk for a developer-led program. This risk refers specifically to the fact that there is always an error index in the estimates of solar radiation, which adds uncertainty to the project.

Evacuation capacity (Tech.4) was identified as a site-specific risk by one respondent for each of the two programmes. In the Zambian case, it refers specifically to the fact that a grid capacity study had apparently not been completed prior to the bidding process. One respondent was therefore concerned that the local grid at the project site would not be able to evacuate the additional generation capacity. In South Africa, developers needed to ensure that the closest sub-station had sufficient capacity to be able to evacuate their power – as previously discussed.

Access to and control of the site (Tech.5) refers mainly to the difficulty in reaching and servicing a remote project site, and was considered as a risk for both types of processes. **Error! Reference source not found.** shows that, for at least one developer, this is an important issue for a developer-led process.

Flood risks (Tech.6) was only mentioned by a single developer for developer-led site-selection processes, and refers to the possibility of damage to the plant due to flooding in the area.

Water availability (Tech.7) is another risk only mentioned by a single respondent in the context of a developer-led process, and again reflects the fact that many of the solar PV plants in the South African programme are situated in remote, arid regions of the country.

The shape of the site (Tech.8) was a risk identified specifically by one developer in the context of the Scaling Solar government-led process. It refers to the fact that the provided project sites are unfortunately not optimally shaped for a solar PV plant; the result is that the PV plant is smaller than one would have expected on a similarly sized plot of land.

4.2.1. Legal risks

The land ownership agreement (Leg.1) appears to be the one risk that features equally for both programs (**Error! Reference source not found.**) – but for slightly different reasons. In the government-led process in Zambia, the two project sites were leased to the IDC by the

Zambian Development Agency (ZDA), who in turn will on-lease these to the project companies⁷. It became apparent in the process (post-award) that parts of the provided sites actually extended onto the adjoining nature reserve. This has required significant additional remedying action, which was perceived as a cause for delays in project realisation by one respondent. In the South African developer-led process, respondents indicated that the uncertainty regarding the land ownership agreement is due to two factors: the possibility of incorrect information in the land registry, and the unwillingness of land owners to extend agreements for projects that have been awarded preferred bidder status, but whose PPA's have not been signed (and have therefore not been able to progress to financial close) due to Eskom's obstructive behaviour.

The potential of failure to achieve land agreements for transmission lines (Leg.2) is another risk mentioned by two developers in the context of a developer-led process, and refers to the fact that power lines to connect the project to the grid often cross multiple properties. It can be quite challenging to secure and maintain the needed agreements from the different property owners for this critical infrastructure.

4.2.1. Permitting

Environmental and other site permitting requirements (Perm.1) have been mentioned for both processes, but features most prominently for developer-led processes (**Error! Reference source not found.**) according to this analysis. While permitting for the site would normally need to have been resolved by the time a bid is submitted for the REI4P, the significant delays in the signing of the PPAs of the latest rounds of bids has meant that several of these approvals have now lapsed, introducing further uncertainty. This therefore poses not only a project realisation risk, but can also impose significant additional costs.

⁷ The project companies formally own and operate the solar PV power plants. In the Zambian case, each of the two project companies is owned by two shareholders - the developer (80%) and the IDC (20%).

Zoning and land use approvals (Perm.2) is another risk mentioned by two respondents⁸ in the for a developer-led process as applied in the REI4P, since there is no guarantee that these will be granted once a project development process is underway. These approvals also require interaction with a number of government spheres (local, provincial, national) and departments (environment, minerals, agriculture), introducing further complexity to the development process.

Obtaining a water use license (Perm.3) is a further risk identified by a respondent in the developer-led South African process, due to the aforementioned location of many of the solar PV plants in arid regions of the country.

4.2.2. Economic risks

The cost of grid connection (Econ.1) was identified by two respondents in the context of a developer-led process, and is a top-ranked risk for one of them (**Error! Reference source not found.**). It refers specifically to the aforementioned Cost Estimate Letter and Budget Quotes from Eskom for grid connection costing. The two respondents complained that there is little visibility in terms of what these costs will end up being, and that they vary widely based on the project site location.

The cost of permitting and site preparation (Econ.2) was mentioned by a developer in the context of the South African developer-led process as a major cost driver, especially due to the fact that there is such limited capacity in the country's professional services industry to provide the services required.

4.2.1. Political risks

Political risks were only mentioned by one of the interviewed developers as a site-specific risk for the Zambian government-led site selection process. The specific risk mentioned

related to the possibility of the expropriation of the PV plant or the land by the host government (Pol.1) – potentially after a change of government or in response to local political or social unrest. Of the five risks mentioned by this particular developer, this was the lowest ranked.

4.2.2. Social risks

Social consequences of land acquisition (Soc.1) refer to potential social unrest around a power plant location [49]; this risk was mentioned in the context of the South African developer-led process, and refers not only to the classic NIMBY (Not In My Backyard) phenomenon that has plagued so many wind power projects in developed countries [44,46,65], but also to a host of other location-specific social risks particular to developing regions. These include the commitments made by projects towards local community ownership of the project, and benefits flowing from the project to the community – in response to specific qualification and evaluation criteria in the South African RFP. Projects are evaluated on 16 different “economic development” indicators, grouped under job creation, local content, ownership, management control, preferential procurement, enterprise development and socio-economic development. A key area of potential concern that was pointed out in the interviews are the local ownership and revenue provisions, which require a minimum 2,5% local community ownership level in the project company, as well as revenue flows equivalent to 1% of total revenue to local communities. These requirements introduce additional complexity to a project, and could lead to unrealistic community expectations not being met, resulting in social unrest. Failure to meet socio-economic development commitments can also result in financial penalties and the cancellation of the PPA. Projects therefore have to continually manage expectations and ensure effective implementation of their socio-economic development plans. It is a long-term risk for projects, and can result in not only project realisation delays, but also project failure (e.g. Kinangop in Kenya) and significant additional costs.

4.2.3. Summary of site-selection risks: a comparison

The analysis of the responses shows that the site itself posed a major risk to the developers in Scaling Solar Zambia Round 1 – seemingly thwarting the original intention for the government in providing and preparing the site. Reasons put forward for this assessment centred mainly on the ability of developers to control the risks they are to bear. While the site risks were considerable in the South African programme for developers, they were able to make informed decisions about their willingness to take on these risks. This was not the case in Zambia, where developers were “forced” to take on site risks that they had no control over and had very poor visibility on. As one developer stated: “we would never have chosen those sites” (Personal communication, December 2017).

Not only were site-related risks much more prominent in the government-led Scaling Solar Zambia Round 1, but the nature of the site-related risks in both programs differ substantially. In the developer-led South African case, most site-related risks are concerned with issues “around” the site, such as permitting, connection agreements and community engagement. In the Zambian case, the reported risks are much “closer” to the actual sites, including the aforementioned geotechnical and land rights problems. These are issues that would normally have been dealt with at a pre-feasibility assessment level by developers in a developer-led programme, before proceeding to the concerns around permitting and connections. From a developer’s perspective, the site-selection risks in Zambia therefore appear to be much more fundamental, raising concerns about the quality of pre-feasibility assessments performed for the programme. Respondents indicated that this might be due to the limited experience of the procurer, the short project preparation timelines, or limited financial provision being made for the necessary assessments.

4.3. Developers' proposals for addressing site-related risks

In the final step of the semi-structured interviews, developers were asked for suggestions in terms of how the site-related risks for both the REI4P and Scaling Solar can be mitigated in the future. In response to this question, developers put forward a number of proposals for better dealing with these risks in subsequent procurement rounds. This would mainly include increasing the level of private sector involvement in the project preparation process. Such involvement could take several forms. One developer mentioned an interesting example from Egypt, where developers grouped together to finance a range of feasibility studies required to enable them to submit bankable proposals. By grouping their financial resources and jointly selecting service providers, these developers were able to significantly reduce the risks of a poorly conducted site selection and preparation process. Their findings and recommendations were used by the procurer to select an appropriate site.

With regard to the Scaling Solar programme, respondents also proposed to expand the timeline and increasing the resources allocated to the site selection and preparation process by the public sector, whether this is the host government or other development partners, to ensure high quality, bankable project data. A further suggestion was to allow developers to propose two sites and associated tariffs when bidding; the first for a government-selected site, the second for a site selected by the developer. This will allow developers to potentially lower their own risk exposure, provide a transparent evaluation of the risks and returns related to each site, and offer potential additional benefits to the procurer in the form of a better site with lower costs. This has been applied in Malawi's first solar PV auction in 2017, and while the projects are yet to reach financial close, it has shown that it is possible to structure a bidding program in a way that tries to have "the best of both worlds".

5. Conclusion and policy implications

This paper analysed and compared the perceived project risks for competitive renewable energy project tendering schemes with different site selection strategies in sub-Saharan Africa. The evidence gathered from project developers in government-led site selection in Zambia's Scaling Solar Round 1, as well as from developer-led site selection in South Africa's REI4P suggests that different general and site-specific risks are present. In Zambia's government-led approach, site-specific risks dominated all other project risks, and centred around several technical issues. In REI4P, such risks were noticeable, yet less pronounced and more evenly spread between different risk categories without significant spikes. These findings challenge the widely held assumption in the real-world [19], as well as the academic literature [13] that pre-selecting a site for a solar PV plant procurement process in SSA translates into a reduced risk profile, lower prices and result in quick project realisation. The type of risks that ended up slowing down the government-led Scaling Solar process have been not only elemental - both in terms of being early stage project development risks, and potential fatal project flaws; more importantly, the nature of the site selection process meant that bidders had limited or no control over these risks.

This has important implications for utility-scale solar PV tender design in SSA. Many of the factors that plagued the Zambian Scaling Solar site selection and preparation process are not unique to the country. Only a handful of countries in the region have managed to realise private-sector led utility-scale renewable energy investments [66], pointing to a regional deficit in the requisite experience, capacity and resources required to effectively scale up these kinds of investments. In this context, the Scaling Solar programme is a welcome development with great potential. Nevertheless, to be effective it is recommended that programmes that entail government-led site selection processes such as Scaling Solar take certain lessons into account, especially on the issue of site selection and preparation. South Africa's experience has shown that the private sector is able to effectively deal with site selection and preparation issues, without compromising on costs or project realisation.

Whether solar PV auctions with government-selected sites in the sub-Saharan region are able to achieve a similar outcome still needs to be proven. We propose that where a procurer opts for a pre-selected site – whether to deal with land rights issues or to reduce costs, or both – it is done in close consultation with the private sector. In addition, it is important that sufficient time and resources are dedicated to this process, and that, where possible, the pre-selected site is an option for bidders, instead of a hard restriction. This article suggests that evaluating the rollout of future renewable energy auctions in Africa and the factors that are central for a successful project implementation can provide greater insight into appropriate risk mitigation strategies for private power investment in the region.

Early indications are that reforms of Scaling Solar are underway, although how exactly these risks are being addressed is not clear at present [67]. This also has implications beyond Scaling Solar, as the success of the rapid rise of utility-scale solar PV auctions in SSA more broadly depends on making appropriate choices on this important topic.

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