Report D4.4-ZM, July 2017

Auctions for Renewable Support in Zambia: Instruments and lessons learnt

Short about the project

Auctions for Renewable Energy Support: Effective use and efficient implementation options (AURES)

This project helps assessing the applicability of different auction types to renewable support under different market conditions. It also explores which auction types and design specifications suit particular requirements and policy goals in European countries. By establishing best practices and a knowledge sharing network, we contribute to informed policy decision-making and to the success of auction implementations across Europe.

Target-oriented analysis: Through analysis of empirical experiences, experiments and simulation, we will create a flexible policy support tool that supports policy makers in deciding on the applicability of auction types and certain design specifications for their specific situation.

Capacity building activities: We undertake specific implementation cases to derive best practices and trigger knowledge sharing amongst Member States. We strive to create a strong network with workshops, webinars, bilateral meetings, newsletters, a website that will serve as capacity building platform for both policy makers and market participants (including project developers, auctioneers,etc.). Wherever required, we can set up specific bilateral and multilateral meetings on specific auction auction issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals.

Project consortium: eight renowned public institutions and private firms from five European countries and combines some of the leading energy policy experts in Europe, with an impressive track record of successful research and coordination projects.

The report contributes to the first and second of three tasks in work package 4 of the AURES project:

T4.1 Providing a characterisation of the different auctions

T4.2 Making an assessment of auctions and case-specific lessons learnt

T4.3 Interpreting and summarising the general lessons learnt and resulting and thereby outline specific recommendations

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1. Characteristics of auctions in Zambia

Country features

With an area of 752 thousand square kilometers, Zambia is a lower middle-income country in Sub-Saharan Africa. It has a GDP of $21.15 billion in 2015 (World Bank 2016) and a population of 16.2 million inhabitants, one of the world's fastest growing, with the UN projecting that it will triple by 2050.

Its economy has experienced a slow down since 2012, with GDP growth rates falling from 7.5% in 2012 to 2.9% in 2015 (2013: 5%; 2014: 4.7). Its over-reliance on copper has made it vulnerable to the fall in copper prices. It is Africa's second largest copper producer and copper is the country's largest export. In turn, this has led to a reduction in the GDP per capita, from 1750$ in 2013 to 1490$ in 2015. Domestic factors include a power crisis from mid-2016 to early-2016, impacting all sectors of the economy, repeated fiscal deficits that have weighed on investor confidence and low and poorly-timed rains which reduced agricultural incomes and increased food prices in 2015. The World Bank forecasts that growth will remain at 2.9% in 2016, before improving in 2017 (4%) and 2018 (4.2%) as the situation in the power, agriculture and mining sectors improve (World Bank 2016).

Life expectancy at birth is 60 years (2014 data)(World Bank 2016) and 60% of the population lives below the national poverty line (2010 data). Agriculture accounts for 56% of total employment, but its contribution to GDP is much more modest (16%). Industry/manufacturing and services are the opposite cases (Industry: 13% contribution to employment, 39% to GDP; services: 26% of employment, 45% of GDP)(Chitonge 2016). Zambia has managed to avoid the war and upheaval that has marked much of Africa's post-colonial history, earning itself a reputation for political stability (BBC 2016).

Energy sector features

Energy production in 2014 amounted to 9.13 Mtoe (with imports of 0.83 Mtoe) and electricity consumption reached 11.05 TWh. Total primary energy supply (TPES) was 10.06 Mtoe.[1] Of the total installed electricity generation capacity of Zambia (2,347 MW), hydropower is the most important energy source in the country with 2,259 MW of installed capacity (96%), followed by diesel, which contributes about 4% to the national energy supply (ZAMBIAINVEST 2017). According to IEA (2017), electricity production in 2014 amounted to 14452 GWh, with 14042 GWh coming from hydro (97.1%) and oil accounting for the rest (410 GWh). Non-hydro RES represented 0 GWh of production. Electricity exports (1250 GWh) outweigh imports (13 GWh). Therefore, domestic supply of electricity amounts to 13209 GWh. Electricity consumption is 10719 GWh. Industry is the largest electricity consumer (60%), followed by the residential sector (30.3%), commercial and public services (6.2%), agriculture (2.2%) and transport (0.2%).

[1] TPES/population: 0.64 (toe/capita). TPES/GDP (toe/thousand 2010 USD): 0.39. Electricity consumption per capita: 0.7 MWh (IEA 2017).

Zambia demand for energy has been rising, particularly in the mining, manufacturing and agriculture sectors. According to the Zambia Development Agency (ZDA), the demand for electricity in the country has been growing at an average of about 3% each year. However, despite this increase in demand, there has not been any major addition to the country's generation capacity in the last 20-30 years (ZAMBIAINVEST 2017). In addition, a severe drought led to hydropower operating at a third of normal capacity (Chase 2016) and a power deficit of 560MW (Parnell 2015, IFC 2015). The situation has not changed, as demand for electricity grows to 200 MW annually (GLI 2017). The subsidization of power prices for households may have also contributed to this situation.[2] The state-owned ZESCO embarked on a countrywide power rationing scheme in its efforts to maximise the power generated from limited water (GLI 2017). As a result, power shortages and black-outs are frequent (IFC 2016b) and scheduled power outages are already having a negative impact on homes and businesses (IFC 2015), in a country with low electrification rates.[3] Only 22.1% of the Zambian population has access to electricity (Scaling Solar 2016), partly due to the location of most areas far from the national grid system (GLI 2017). Zambia expects to bring an additional 2,000MW of hydro and thermal power online in 2016 and 2017 (USAID 2016a).

The current electricity deficit has had a major impact on the future direction/policy in Zambia, leading to increased investment in the development of new hydro power plants, a focus on the development of thermal power plants, investments into solar energy plants, the establishment of mini hydro and biomass plants and petroleum and gas exploration (GLI 2017).

Regarding the structure of the electricity generation sector, there are currently three main electricity companies in Zambia: The vertically integrated state-owned utility ZESCO, the Copperbelt Energy Corporation (CEC:LUSE) and the Lusemfwa Electricity Company (Zambia Development Agency 2014). Although there are pockets of private sector activity in generation, transmission, and distribution, the vast majority of power in Zambia is operated by ZESCO (USAID 2016a), which runs and operates power stations, transmission lines and distribution networks (Zambia Development Agency 2014, GLI 2017).

Renewable energy in Zambia

Hydro

Hydropower is the most important energy source in the country after wood fuel, contributing about 10 percent to the national energy supply (Zambia Development Agency 2014). Generation of electricity in Zambia is predominantly from three main hydropower stations (Kafue Gorge, Kariba North Bank and Victoria Falls).

However, as mentioned above, there has not been any major addition to the country's generation capacity in the last 20-30 years, despite the huge potential in hydro resources. Zambia has 40 percent of the water

[2] According to Chase (2016), they are around $0.06/kWh, which is below the cost of generation.

[3] According to the World Bank (2017), the capital of Zambia (Lusaka) experienced 137 hours of outages per customer in 2015.

resources in the Southern African Development Community. Zambia has about 6,000 MW unexploited hydropower potential, while only about 2,177 MW has been developed (Zambia Development Agency 2014).

Due to the below average rainfall during the 2014/2015 rain season, water inflows into the reservoirs has not been adequate to meet the national power requirement until the end of 2015. In response, the Zambezi River Authority reviewed the water allocation to ZESCO for hydropower generation from 45 billion to 33 billion cubic metres for the period March - December 2015 in order to allow generation to last till the next rain season. This led to a shortfall in power generation of about 560 MW.

In order to mitigate the reduced power generation caused by the lower water levels, ZESCO began implementing revised load shedding schedules of between 5 and 6 hours for the domestic, industrial and commercial customers on a rolling basis through a 24 hours period. Based on hydrological forecasts, ZESCO was further advised to reduce power generation beginning in July 2015, from the earlier recommended 700 MW to 540 MW and from 600 to 305 MW for Kafue Gorge and Kariba North Bank, respectively. This has led to a further reduction of 455 MW (Government of Zambia 2016).

SOLAR

The need to diversify energy sources for electricity generation has brought solar to the fore. Zambia has an average of 2,000-3,000 hours of sunshine per year but PV power penetration has remained relatively low. The PV market remains dominated by Government, NGOs and donor funded projects, with the World Bank (WB) being the largest financing agency in the sector. Annual sales are in the range of USD 2 million to USD 3 million, with 70% being donor-financed projects (ZAMBIAINVEST 2017). The exact amount of solar capacity that can be absorbed by Zambia's grid is unknown. The technical limitations of the grid is one challenge facing developers, and another is Zambia's extremely low power tariffs, which discourage investments in new generation capacity (The Economist 2016). Other barriers to RES in the country include cumbersome administrative procedures, lack of a feed-in tariff or a transparent way to establish it as tenders, the depreciation of the national currency (Kwacha), lack of awareness/expertise in the financial sector and high costs of finance and lack of human capacities and resources during the project preparation phase (Lucas 2016, p.12).

A critical barrier is financing. Renewable developers are offered interest rates as high as 30%, which is prohibitive for most commercial applications, as well as too short pay back periods. The Scaling Solar program aims to address some of these barriers.

THE ROLE OF THE WORLD BANK: THE SCALING SOLAR PROGRAM (ENERGY AUCTION)

The auction in Zambia promotes solar PV as a way to mitigate the hydro deficit and contribute to the electrification of the country. Following the severe energy crisis in Zambia in 2015, the President of Zambia directed the IDC (Industrial Development Corporation Zambia Limited, a state-owned investment company, see below) to expand the country's PV infrastructure (IDC 2016). In collaboration with the World Bank under the Scaling Solar programme, the first tender round was carried out for the first two 50 MW_p power plants.

Overall, 600 MW_p are expected to be installed by contractors in several tender rounds (Rödl and Partner 2016).

The aim of the program is to promote renewable energy (especially solar) in developing nations, which it does by offering various services to reduce the risks and the costs for investors (PV Magazine 2016). It is supported by debt financing and the World Bank's insurance products (Ola 2016). Zambia represents the inaugural project for this program.

It is a "one stop shop" program aims to make privately funded grid-connected solar projects operational within two years and at competitive tariffs[4]. Scaling Solar provides advice to assess the right size and location for solar PV power plants in the country's grid, simple and rapid tendering to ensure strong participation and competition from committed industry players, fully developed templates of bankable project documents that can reduce negotiation time, concessional financing and insurance attached to the tender, delivering competitive bidding and ensuring rapid financial close, risk management and credit enhancement products to lower financing costs and deliver power at lower tariffs (Lucas et al 2017).

Three main actors in this context are IDC, the World Bank and ZESCO.

1.- IDC: IDC is an investments holding company wholly owned by the Zambian government. IDC's mandate is to play a catalytic role in deepening and supporting Zambia's industrialization capacity to promote job creation and domestic wealth formation across key economic sectors. The IDC plays its role through evaluation, pricing and lowering the investment risk profile by serving as co-investor alongside private sector investors. IDC is the investment vehicle. Local Zambian participation in the two auction projects will be ensured through IDC taking a 20% shareholding in each of the two project companies (IFC 2016a).

2.- The World Bank Group: The financing for the power plant's development and construction will be provided by investors or through financing packages of the World Bank. Two institutions of the World Bank played a key role in the auction in Zambia, the International Development Association (IDA) and the International Finance Corporation (IFC). IFC is responsible for the supervision of the entire process all the way from project preparation through to project audit and financing to the commissioning of the large-scale PV plants, IFC acted as lead transaction advisor to the Government of Zambia and helped run the tender process for the two projects. The terms of the loan can be improved through the payment guarantee given by IDA (USD 15-20 million for the first 100 MW)(Rödl and Partner 2016).

[4] The package includes: 1) Advice to assess the right size and location for solar PV power plants in a country's grid; 2) Simple and rapid tendering to ensure strong participation and competition from committed industry players; 3) Fully developed templates of bankable project documents that can eliminate negotiation and speed up financing; 4) Competitive financing and insurance attached to the tender, delivering competitive bidding and ensuring rapid financial close; 5) Risk management and credit enhancement products to lower financing costs and deliver power at lower tariffs (Lucas 2016).

3.- The state utility ZESCO is the off-taker: The IPP will conclude a PPA with ZESCO, with the agreement being based on the price bid by the candidate.[5]

The contribution of the World Bank is very useful in several respects. According to Eckhouse and Hirtenstein (2016), the program is designed for countries with limited independent power producer experience and with single-buyer markets, where the buyer of power is a publicly-owned utility. Zambia has a distressed macroeconomic situation, weak institutional capacity in the energy sector and lack of a sophisticated and liquid financial market (ZBT 2016). The country is ranked 98 in the Doing Business report (World Bank 2017). Therefore, the Bank's guarantee to back-stop the obligations of the national utility to pay for the electricity being supplied is critical to address the risks associated with these factors (ZBT 2016). The Solar Scaling program helps overcome international banks' concerns about political risk and makes the Zambian emerging market more appealing to developers (Eckhouse and Hirtenstein 2016). It also includes standardized contracts, eliminating the often lengthy process of negotiating power-purchase deals one at a time.

Table 1. Characterisation of auctions in Zambia

Characteristics	**Description**
Country characteristics	See text
Market characteristics	See text
Name of auction scheme	Utility-Scale Solar Photovoltaic IPP Projects in Zambia
Objectives	The main motivation is to mitigate the electricity capacity deficit and increase the electrification rate of the country (see text). Tenders prepared with the support of Scaling Solar are intended to deliver the following benefits to governments and bidders: 1) Balanced agreements and bankable project documents. 2) Credit-approved term sheets for financing, political risk insurance and partial risk guarantees 3) Competition, transparency and speed (IDC 2015)
Contracting authority	The developers will implement these projects through special purpose companies, to be established and incorporated in Zambia by IDC or developers specifically for this purpose, at locations to be identified by IDC (IDC 2015). The Seller will enter into:

[5] See Rödl and Partner 2016 and https://www.scalingsolar.org/ for further details.

Characteristics	Description
	-a PPA with ZESCO (Purchaser), under which the Seller will, subject to a set of operational performance standards set out in the PPA, sell to the Purchaser all of the electricity generated by the project; -a Government Support Agreement (GSA) with the Government of Zambia, under which the latter will provide certain protections and other support to the project (IDC 2015, p.8)
Main features	-Site-specific solar PV auctions. The two projects will be located in the Lusaka South Multi-Facility Economic Zone. They will be constructed on two separate land sites and will be independent of each other in terms of ownership, operation and location (IDC 2015, p.8). IDC selects those sites. -Utility-scale solar PV projects. -Single item, price-only, first-price sealed-bid auction. -Strong role of the World Bank (Scaling Solar program). -No updating of support levels over time
Year of introduction	2016
Technology focus and differentiation	Solar PV only
Lead time before auction	Request for prequalification (RFQ): published in October 5th 2015. Meeting with prospective bidders: 23 October 2015 Lusaka. Closure of RFQ process: 13th November 2015. Submissions of final proposals: April 8th, 2016. Bids opened by IDC on May 27th 2016 Results published on May 30th 2016.
Min./max. size of project	Yes, maximum size of 50 MW
What is auctioned?	Capacity.

Characteristics	Description
Budgetary expenditures per auction and per year	Not available
Frequency of auctions	No schedule of auctions has been set. Overall, 600 MW_p will be installed by contractors to be selected in several tender rounds. A recent note from IDC states that round 2 will be for 150MW - 150MW, with round 3 for the remaining 250MW - 350MW to be announced shortly thereafter (IDC 2017).
Volume of the tender	100 MW (two projects of 50MW each)
Auction design elements	See Table 2

1.1 Design elements for the assessment of auction schemes for RES-E

Table 2. Design elements for the assessment of auction schemes for RES-E

Design elements	
Single- or multiple-item auctions	Single item
Auction procedure	First-price[6] sealed bid.
Pricing rules	First-price. A tariff nominated in U.S. dollars is provided for 25 years.
Ceiling price	No
Qualification criteria	Experience, expertise and financial resources are required. Prospective bidders will be required to register with IDC and purchase the RFQ document for a non-refundable fee of 1000 Kwacha (IDC 2015). TECHNICAL QUALIFICATION: Prospective Bidders shall be required to demonstrate experience of developing, constructing and operating at least one of the following (each a Technical Criterion) and to submit proof thereof:

[6] A winning bidder can either be paid the price set in his own bid (first-price auction) or the price offered by the second-cheapest bidder (second-price auction (AURES website: http://auresproject.eu/about-auctions/auction-formats/pricing-rules)

Design elements

(a) one or more grid-connected solar photovoltaic power plants in Africa with a minimum aggregate capacity of 25 MW;
(b) one or more grid-connected power plant(s) of any technology in Africa with a minimum aggregate capacity of 75 MW;
(c) at least three grid-connected solar photovoltaic power plants, each in a different country anywhere in the world with a minimum aggregate capacity of 100 MW; or
(d) one or more grid-connected power plant(s) of any technology anywhere in the world with a minimum aggregate capacity of 1,500 MW (IDC 2015, p.12).

FINANCIAL QUALIFICATION:
A Prospective Bidder shall be required to satisfy one of the following two financial prequalification criteria (each a Financial Criterion):
(a) if the Prospective Bidder comprises a single entity, such entity shall have had (i) a Net Worth of at least US$75m or equivalent and (ii) a Net Worth to Total Assets ratio of at least 15%, in each case as at the end of each of the most recent two full financial years for which audited financial statements are available as at the deadline for responding to this RFQ; and
(b) if the Prospective Bidder is a Consortium, then: (i) the Anchor Sponsors shall (A) between them have had a Net Worth of at least US$75m or equivalent and (B) each have had a Net Worth to Total Assets ratio of at least 15%; and (ii) the Lead Sponsor shall have had (A) a Net Worth of at least US$37.5m or equivalent and (B) a Net Worth to Total Assets ratio of at least 20% (IDC 2015, p.13).

BID BONDS AND OTHERS

Guarantee	**Set-up day**	**Amount**	**Duration**
Bid bond	Bid submission	1.3 M$	6 months
Decommissioning bond	One year before the PPA termination.	4.4 M$ (100 K$/MWp)	2 years
Performance bond	PPA	15 M$	26 years
Credit support letter	NTP	Amount equal to the investor's equity	1 year

Source: Cammisecra (2016).

Design elements	
Penalties	Contract termination, bid bond withheld.
Monitoring of realisation progress	Non-available
Exceptions from requirements for small plants/developers?	No Only lower financial qualifications for smaller actors: “As an incentive to encourage the participation in consortia of small and medium-sized Zambian enterprises, for the purposes of financial prequalifications only, a multiplier of 1.5x shall be applicable to the Net Worth of any Anchor Sponsor that is a citizen-owned company (as defined under the Public Procurement Act 2008) up to a maximum of US$10m of Net Worth (pre-multiplier) and US$15m of Net Worth (post-multiplier)” (IDC 2015, p.14).
Support auctioned	Bidders offer a price per kWh. The project with the lowest price per kWh is selected for a PPA. The tariffs will remain fixed for 25 years (i.e., no updating of support levels over time, i.e., with inflation).
Transferability of support right	No

2. Evaluation criteria for the assessment of auction schemes for RES-E

Actor variety and social acceptability

The competitive auction organized through the program attracted 48 solar power developers. 11 were qualified and seven submitted final proposals (IFC 2016a)(table 3). Thus, a considerable amount of actors have been attracted. They were mainly large, well-established companies, with company domicile mostly in Europe, and three in China, South Africa and Mauritius. Two companies were awarded contracts: Neoen/First Solar and Enel Green Power, although the former submitted the lowest bids for both sites. However, the Scaling Solar tender does not allow awarding both sites to the same bidder, which increases actor diversity (at the expense of higher support costs)(Lucas et al 2017). Recall that Local Zambian participation in the two auction projects will be ensured through IDC taking a 20% shareholding in each of the two project companies, but there is not a local content requirement.

Table 3. Participants in the Zambian auction process.

Developers	Description	Country (Domicile)	Pre-qualified	Submission of final proposal	Winners in the auction
EDF Energie Nouvelle	Development spinoff of French utility EDF.	France	YES	YES	NO
Scatec Solar	Independent solar energy provided	Norway	YES	NO	NO
Access Eren Zambia 1	Dubai-French consortium	France	YES	YES	NO
Mulilo Zambia PV1 Consortium	Unknown consortium	South Africa	YES	YES	NO
Enel Green Power (EGP)	Italian development spinoff of utility Enel	Italy	YES	YES	YES
Globeleq	London-based Africa-focused developer.	United Kingdom	YES	YES	NO
International Power SA/Engie	A multinational electricity generation company	Belgium	YES	NO	NO
Neoen First Solar	French developer NEOEN and US thin-film manufacturer partnership	France	YES	YES	YES
Shanghai Electric Power/Avic	Chinese consortium of utility and (presumably) aviation firm.	China	YES	YES	NO
Africa Infrastructure Investment Fund 2 – Old Mutual Life Insurance Company – Cobra/CDE	Investment fund	Mauritius	YES	NO	NO
Grupo T-Solar, SA	Subsidiary of Isolux Energy Investments	Spain	YES	NO	NO

Source: Own elaboration. Description of the companies submitting proposals based on Chase (2016).

Given the relatively small size of the two projects being awarded in the auction, the fact that they aim to cover an electricity capacity gap, and that several stakeholders argue in favour of a diversification of the country's energy sources (GLI 2017), no strong social backlash against them can be expected. In fact, compared to other alternatives to cover the electricity deficit (importing and generating with coal, buying expensive emergency power from offshore ships in Mozambique and rasing tariff rates), solar is likely to be a socially acceptable option (Climatescope 2016).

Policy effectiveness (effectiveness of auctions).

Whereas 100 MW were auctioned for the two projects (50 MW each), the total amount to be built will be 73 MW (45 MW and 28 MW), i.e., 27 MW lower than the 100 MW initially envisaged.

Both projects will be located in the Lusaka Multi-Facility Economic Zone in Southern Zambia. The First Solar project is scheduled to be completed by mid-2017. The power plant will cover an area of just over 52 hectares and will be powered by around 450,000 First Solar modules (Ola 2016).

The Enel Mosi-oa-Tunya PV solar project is expected to produce around 70 GWh per year. Enel will be investing approximately 40 million US dollars in the construction of the solar facility, which is expected to enter into operation in the second quarter of 2017 and will generate around 70 GWh per year (Enel 2016).

It is difficult to know at this stage whether the projects being awarded contracts will be built since the process is at an early stage. The fact that the two winners are well-established international companies as well as the reduction in the risks under the Scaling Solar program suggest are reasons for optimism in this regard. The World Bank's support has helped to derisk the financing and achieve the interest rates and equity hurdle rates needed to deliver this project commercially (Chase 2016)[7]. Antonio Cammisecra, head of business development at Enel Green Power in Rome claims that the program facilitated entrance by Enel in Zambia, and accelerated entry by a couple of years (Eckhouse and Hirtenstein 2016).

Static efficiency or cost effectiveness (including transaction and administrative costs)

The Zambian auction has led to remarkable low prices. The NEOEN/First Solar project has been awarded with 6.02cents$/kWh and the Enel Green Power has been awarded with 7.84cents$/kWh (both for 25 years). The bid tariffs ranged from US¢ 6.02/kWh to US¢ 10.6/kWh (see below).

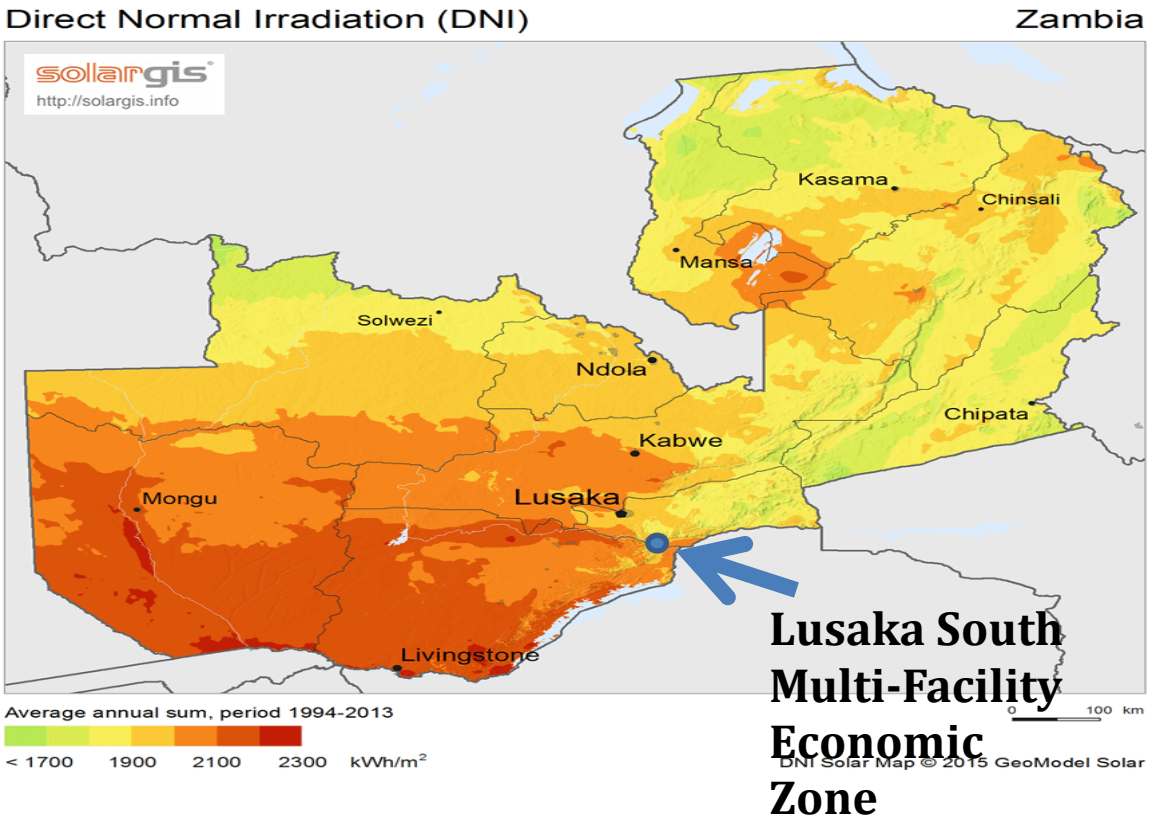
The low winning auctions can be partly related to the low risks facilitated by the Scaling Solar program, but also to the fact that land is provided for free by the Zambian Government (Climatescope 2016). The Scaling Solar program helps to reduce risks, financing costs and, thus, the LCOE, leading to lower bid prices as a result. According to USAID (2016b, p.6), the concessional lending provided by the World Bank made these projects commercially viable since such involvement brings down the cost of debt to 6% and the cost of equity to 10%. The denomination of PPAs in dollars further reduces currency risk for investors. This reliance on concessional lending (vs. commercial banks) makes Zambia’s auction different from those held elsewhere (Latin America and India). This is deemed an appropriate derisking tool in order to increase interest in the first ever competitive auction for RES in Zambia (USAID 2016b, p.6).

[7] Zambia has a high cost of capital; yields on government bonds in kwachas (Zambian’s currency) maturing in 2031 are currently around 14%. Dollar-denominated bonds yield 10-12%. Bloomberg New Energy Finance estimated in the April 2016 note that debt in Zambia needs to pay interest of 11.7%, and projects must offer a return on equity of 14.7% (Chase 2016).

The choice of the site seems to have been an issue. The RFQ states that “technical and legal due diligence is ongoing to identify and secure potentially suitable sites for detailed feasibility analysis. To date IDC has identified one particular site, in the Lusaka South Multi-Facility Economic Zone, which has appears to have strong potential” (IDC 2015, p.23). However, Eckhouse and Hirtenstein (2016) report criticisms by the head of business development at Enel Green Power in this regard, stating that “the location of the project isn’t ideal (…), it’s not flat and has rocks that will need to be removed (…). It is the last site you would choose to do a solar project. The end result is a higher cost which means a higher tariff. If the site could have been selected by the investors, it would have resulted in a lower tariff”.

In addition, the sites (in the Lusaka South Multi-Facility Economic Zone) do not seem to be located in the region with the highest level of solar radiation in Zambia, although the solar radiation in the specific places where the projects will be located is unknown (Figure 1).

Figure 1: Solar potential in Zambia



Source: RECP (2017).

If this is so, then the allocative efficiency of the scheme would not be maximized. However, under a system costs perspective, the indirect generation costs should also be taken into account[8]. Although the sites would

[8] Indirect costs refer to balancing, profile and grid costs. Balancing costs occur due to deviations from schedule of variable RES-E power plants and the need for operating reserve and intraday adjustments in order to ensure system stability. Profile costs are mainly back-up costs, i.e., additional capacity of

be on even gradients, and may require reinforcement before construction, an advantage of the sites is the proximity of the solar farms to a new substation (Eckhouse and Hirtenstein 2016). This is a critical issue for system costs, given the underdevelopment of the grid and its difficulties to integrate variable RES (IRENA 2013, The Economist 2016). The pre-selection of sites in Zambia is related to the lack of assessments of the stability of the grid and the weak grids in these countries, which encourages the location of projects close to the grid. The case of Zambia as well as other Sub-Saharan countries shows that, when there is a weak grid and obtaining administrative permits is burdensome, site-specific auctions may be particularly recommendable (Lucas et al 2017).

Dynamic efficiency

The technological diversity provided by the project is high regarding the electricity generation sources in Zambia (since there was no solar PV connected to the grid), but low in the sense that the only RES supported by the auction is solar PV. The impact on the local PV supply chain will likely be low, since this is non-existing in Zambia and most investors are not local ones.

Compatibility with market principles and integration

The energy generated by the plant will be sold to ZESCO, the state-owned utility company, under a 25-year PPA. There is not a wholesale electricity market in Zambia, and, thus, the criterion ”compatibility with market principles” does not apply. Since the project is close to a substation, grid integration is facilitated.

Distributional effects & minimization of support costs

As mentioned above, the winning bid prices have been low, which would result in low support costs. Again, the lower risk due to the participation of the World Bank has likely contributed to lower bids. The next table 4 provides the bids submitted by the qualified actors, with the winning bids in bold. IDC was very pleased with the level of competition (IFC 2016a).

Table 4. Bids submitted in Zambia’s auction.

	West Lunga site	**Mosi-oa Tunya site**
Neoen/First Solar	**6.0150**	6.1350
ENEL Green Power	7.7989	**7.8390**
Access/EREN Zambia 1	8.2879	8.9509
Mulillo Zambia PV1 Consortium	8.4000	8.4000

dispatchable technologies required due to the lower capacity credit of non-dispatchable RES-E. Grid costs are related to the reinforcement or extension of transmission or distribution grids as well as congestion management, including re-dispatch required to manage situations of high grid load (Breischoft and Held 2013). See del Río et al (2015) for further details.

EDF Energies Nouvelles	10.0400	9.9850
SEP/AVIC Intl	10.600	10.600

Source: Tavoulareas (2016).

The winning prices are the lowest in sub-Saharan Africa to date (Eckhouse and Hirtenstein 2016, Scaling Solar 2016). IDC noted that the two provisional winning tariffs are both well below those typically offered under unsolicited proposals from solar developers in Zambia or elsewhere in Africa (IFC 2016a). Tavoulareas (2016) shows that the prices provided in Zambia are well below those provided by other Sub-Saharan countries. However, Chase (2016) argues that the fourth round of the South African auction led to lower prices.

On the other hand, some positive local impacts are likely to occur. First, the project contributes to expand the country's generating capacity by 5%, providing a clean power source for the country, in a context of an electricity capacity deficit. In addition, it will probably lead to water savings. According to First Solar, its project will "displace the need for 125 million litres of water that would have been consumed by conventional generation" (Ola 2016).

3. Lessons learnt: key best practices and pitfalls identified

- Zambia should be lauded for being one of the first countries in Sub-Saharan Africa to run a solar tender efficiently and effectively (The Economist 2016). This case suggests that auctions can be an effective and cost-efficient way to introduce non-hydro renewable energy sources in countries with little existing experience in these sources such as those in the Sub-Saharan region in Africa. RES in general and large-scale solar power plants promoted through auctions are regarded as a way to mitigate power shortages, which are common in those countries and increase the electrification of the country.

- At a more general level, these results are dramatically shifting perceptions that low costs for renewable energy are unattainable in poor countries with weak institutions, underdeveloped laws and regulations, and high costs for conducting business (ZBT 2016).

- It clearly shows that, in the context of those countries, the auction procedure should be combined with policies and instruments which directly reduce the financing costs and participation risks in order to have appropriate competition levels and low bid prices. At a more general level, it suggests that auctions must be part of a more comprehensive combination of measures (policy mix) and, particularly, they should be part of a broader package of measures aimed at de-risking and capacity building (need for technical assistance for the design and implementation of the auction processes)(Lucas et al 2017).

- More specifically, international institutions, such as the World Bank, can play a very relevant role in this context. In particular, the World Bank Scaling Solar programme has contributed to mitigate international banks' concerns about political risk, reducing the costs of capital and making these emerging markets more appealing to developers (GLI 2017).

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