Polycentric Governance and Africa's Energy Transition

Introduction

The vaunting ambition embedded in Sustainable Development Goal 7 can be appreciated by contemplating the challenge of ensuring access to affordable, reliable, sustainable, and modern energy (United Nations, 2015) for everyone in sub-Saharan Africa, by 2030. This is a region where around two in three people – over five hundred million individuals – currently lack access to electricity (SE4All, 2017), and the rate of improvement in this dismal statistic is expected to lag behind every other continent (Bazilian *et al.*, 2012). In addition, there are huge variations in access across both urban and rural environments, and between high and low-income groups (Mitchell, 2008; Bridge *et al.*, 2013). In Zambia, a focus of this paper, overall electrification rates of 32% (World Bank, 2016) mask the differential between urban access of 60% and rural access of just 4% (SE4All, 2017). The requirement of universality that is core to the SDGs, underlines the extent of the challenge.

Africa's energy demands have doubled in the past two decades, and will likely double again within the next fifteen years (IEA, 2014). Meeting this growth in demand will require incremental generation capacity of 900,000 megawatts (Eberhard *et al.*, 2017). Under almost any scenario that results in universal access to clean energy, solar photo-voltaic (PV) technology will need to play a critical role. There are many reasons for optimism regarding its uptake: growth in solar PV capacity has trebled over the past four years, while the share of global power generation from solar has more than doubled over that period (BP, 2017). However, in common with rates of electrification, the trends in PV adoption and diffusion vary widely within and across African countries. This represents a major challenge to meeting the objective of rapid, inclusive, equitable, and sustainable reductions in energy poverty across the continent.

This paper proposes that the market forces driving patterns of PV diffusion in Africa (Bazilian *et al.*, 2013; Rolffs, Ockwell and Byrne, 2015; Ockwell and Rob Byrne, 2017) are heavily influenced by the presence of multiple centres of semi-autonomous decision making within the continent, across overlapping jurisdictions at various levels of scale. These arrangements can be described as polycentric, and are traditionally associated in the academic literature with complex forms of governance. The paper argues that there are socio-cultural and political advantages that uniquely accrue to a functioning polycentric governance system; which, in the context of Africa's energy transition, could materially accelerate PV diffusion. Conversely, where polycentric conditions exist but are not associated with a functional governance system, then the rate of PV diffusion will be lower. Ensuring the development and persistence of a functional system of polycentric governance – involving co-ordination between units and providing appropriate mechanisms for conflict resolution – should therefore be a fundamental priority for policy and development actors seeking the rapid and sustainable diffusion of solar PV in Africa.

Energy systems at scale have polycentric attributes; involving many states and actors (Goldthau and Sovacool, 2012). However, the conditions precedent for a functioning polycentric governance system go well beyond the simple presence of arrangements associated with polycentricity (Carlisle and Gruby, 2017). The paper applies a conceptual framework of polycentric governance to an analysis of Zambia's transition to renewables in general, and solar PV in particular. The analysis is subsequently widened to a broader discussion of polycentric governance and the challenge of solar power uptake and diffusion in Africa.

Conventional grid-connected electricity systems are generally technically interdependent, with large centralised generating assets and monopolistic models of distribution. These systems interact with very many actors, institutions, laws, regulations and policies, all of which have evolved over many decades (Goldthau, 2014). By contrast, localised solar PV installations in Africa are a new and emerging technology, with the potential to be disruptive to the horizontally and vertically integrated systems that make up large scale electricity infrastructure. Notwithstanding socio-technological innovation, grid-connected, centralised generating assets are likely to remain a key part of the energy mix for the foreseeable future in most African countries, if universal access to electricity is to be achieved. There is therefore both a governance and a resilience challenge in aligning embedded, centralised energy infrastructure, with local and contextualized technological solutions as characterised by solar PV. Moreover, as the models of diffusion evolve, the governance arrangements will need to be adaptive and dynamic (Goldthau, 2014), if the overall system is to remain resilient, and fit for purpose.

Conceptual framework: polycentric governance

The concept of polycentricity is traditionally associated with complex forms of governance, and has evolved from work by common pool resources scholars, most notably Vincent and Elinor Ostrom. At its core, a polycentric system features multiple centres of decision making that operate with some level of autonomy (Ostrom, Tiebout and Warren, 1961; Ostrom, 2005). Defining characteristics include 'nestedness' at different jurisdictional scales, combined with governance units that cut across jurisdictions (Ostrom, 2005; McGinnis and Ostrom, 2012), to create a multi-level, overlapping framework (Andersson and Ostrom, 2008). As Sovacool (2011) notes, polycentricity shares similarities with concepts including "adaptive governance" (Folke *et al.*, 2005) "polyphonic federalism" (Schapiro, 2005) "interactive federalism" (Sovacool, 2008a; 2008b) "multilevel governance" (Bulkeley and Betsill, 2005) and "consociational" forms of power sharing (Lijphart, 2004).

A critical distinction can be made between arrangements in a polycentric environment – featuring multiple, overlapping and semi-autonomous decision-making units – and a polycentric system, involving co-ordination between these units and a mechanism for conflict resolution (Pahl-Wostl and Knieper, 2014; Marshall; Graham R., 2015; Carlisle and Gruby, 2017). Polycentric environments can be created as much by accident as by design; and may be a product of one or a combination of drivers including technological change, resource scarcity, or government fiat. But the benefits of polycentric governance only accrue when a functional system is present. These benefits include: greater adaptability in response to economic, social or environmental change; a good institutional fit to meet the varied requirements of different actors; and a mitigated risk of institutional failure, due to the embedded redundancy from multiple decision-making units (Carlisle and Gruby, 2017).

While monocentric models of governance envisage government as the primary actor, polycentric governance requires "diverse types of organisations drawn from the public, private and voluntary sectors that have overlapping realms of responsibility" (McGinnis and Ostrom, 2012, p.15). This characterisation more closely reflects the governance dynamics in which solar PV is currently being adopted and diffused in much of Africa. While these organisations typically exert a degree of autonomy in their decision-making process, the decisions they make are based partly on the activities (or lack thereof) of other members within the system. Their interaction with other organisations may be characterised in terms of cooperation, competition,

conflict, and conflict resolution (Ostrom, Tiebout and Warren, 1961). The outcomes of this interaction can – but not necessarily do – result in self-organising adaptive governance systems that function without external direction.

Adaptive management and plurality

The claimed advantages of polycentric governance include enhanced adaptive management (Blomquist, 2009) through plurality; more accountability; and increased participation (Sovacool, 2011). The advantage of plurality derives from the perception that having more choices available should enable better choices to be made (which is not of course to say that the *best* choice is necessarily always made). Adaptive responses may include the design of new institutions, as well as experimentation with multiple interventions that create opportunities for fresh innovation. On this basis, polycentric systems have an advantage over monocentric arrangements when adapting in response to actual or expected changes in the operating environment (Folke *et al.*, 2005; Blomquist, 2009; Pahl-Wostl, 2009; da Silveira and Richards, 2013; Bixler, 2014; Marshall; Graham R., 2015), because decision makers can learn from the successes and failure of others, thereby developing more effective institutional capabilities through iteration. Institutional diversity is an explicit enabling condition of polycentric governance (Carlisle and Gruby, 2017), as it is deemed to amplify the opportunities for experimentation and iteration that are characterised by adaptive capacity.

Polycentricism can improve accountability, for example by reducing regulatory capture, while having decision-making units operating at multiple scales can increase their salience to local actors, encouraging higher levels of participation (McGinnis, 2006). However, for these conditions to occur, generally applicable rules and norms must be in place that put some boundaries on the breadth of actions that decision-making units can take. These rules and norms should be sufficiently accommodating to incentivise experimental and problem-solving behaviour, but suitably rigorous to allow new units to enter the arena, particularly under circumstances where the status quo is failing to meet the requirements of the governance system (Ostrom, 1999). This function is particularly important when the system is subject to sudden or acute change.

For the advantages of polycentric governance to be manifested through a self-organising system, embedded processes for deliberation and learning are necessary (Folke *et al.*, 2005; Blomquist, 2009; Berkes, 2010; Stefan, 2014). Deliberation includes social interactions such as informed dialogue between and across decision-making organisations and other actors (Dietz, Ostrom and Stern, 2003), that is consolidated and codified as a learning outcome. Without this process, polycentric arrangements would not deliver as much in terms of adaptive management, as instead of converging towards best practices, organisations would depend on trial-and-error to progress, with all the delay and inefficiency that this implies. However, creating a socially interactive environment that is conducive to dialogue deliberation and learning across organisational units and at different scales presents both structural and logistical challenges, not least given the requirement of institutional diversity. In the case of solar PV diffusion in Africa for example, it may be that the number of relevant organisations are relatively few, such that organising multi-stakeholder participatory events is logistically fairly straightforward. However, the risk of institutional capture remains, where familiarity breeds informality and mimetic behaviour, dulling the capacity for adaptive learning. Equally, participatory events may be vulnerable to capture by vested interests, who exploit power asymmetries to pursue hegemonic interests that deliberately undermine deliberation and learning, in order to further their own agenda (McCay, 2002; Adger, Brown and Tompkins, 2005; Bixler *et al.*, 2016; Carlisle and Gruby, 2017).

For the advantages of adaptive management within a polycentric governance system to be fully realised, commons scholars argue that there is an absolute necessity to hold decision makers accountable for any failure to deliver against what is expected of them. It has been proposed that traditional measures of accountability such as elections and public hearings (Skelcher, 2005), may not be fit for purpose under polycentric arrangements due to the plurality of organisations; dispersing decision-making authority across a wide range of actors whose overlapping relationships may obscure the lines of accountability (Blomquist and Schlager, 2005). Conversely, (Sovacool, 2011) argues that polycentricity may in fact facilitate greater accountability because it is harder for parochial interests to capture multiple levels of government; a view supported by (Ostrom, 2000) who suggests that multiple levels of power at different scale augments transparency, providing more checks and balances within the system.

For polycentric systems to be sustainable, commons scholars identify that some mechanism to resolve conflicts must be in place (Ostrom, Tiebout and Warren, 1961) that ideally draws on semi-formal arrangements, rather than deferring to more centralised governance structures that tend to concentrate decision making and control. The literature is relatively sparse on how these arrangements might work within a multi-scalar, cross functional institutional environment, but Carlisle and Gruby (2017) refer to the "variety of approaches" (p. 24) that may be available to suit different contexts, including conciliation, mediation and arbitration.

Institutional Fit

In the commons literature, 'institutional fit' generally refers to the congruence between institutions and the need that they are there to address (Lebel *et al.*, 2006; Folke *et al.*, 2007; Carlisle and Gruby, 2017). A typology of fit is offered by Epstein *et al.* (2015) that emphasises institutional alignment with the spatial, temporal and functional characteristics of the ecosystem; and also, institutional alignment with the interests and values of actors within the system. Meanwhile, Blomquist (2009) considers fit in terms of system decomposability. The nested hierarchy that is a characteristic of polycentricism includes decision-making at different sub-system levels. An effective governance arrangement would need institutions that were capable of integrating context-specific decisions being made at the sub-system level, with system-wide decisions being made by units further up the hierarchy. Taken together, institutional fitness is a complex requirement that engages different human interests and behaviours within decision-making environments operating at multiple scales. Given this complexity, Blomquist (2009) proposes that a governance system needs to be similarly multi-faceted if it is to be effective. Institutional heterogeneity – i.e. actors from the private sector, NGOs and government, operating at different scales across multiple jurisdictions – may help to advance fitness, as they bring complementary knowledge and experience to bear (Folke *et al.*, 2005)

Commons scholars identify that a key challenge to institutional fit, includes the mismatch between the spatial scale of an ecosystem, and the jurisdictional authority of the decision maker. The governance problems may be local and specific, such as transboundary pollution or managing natural capital such as fish stocks; but could equally be systemic, such as controlling net carbon emissions. The literature on effective polycentric governance systems proposes, therefore, that the scope of decision-making authority needs to be coterminous with the problem being addressed. To the extent that there is a mismatch of scale, the theory further proposes that new decision-making authorities with appropriate jurisdiction could enter the system to strengthen the governance system.

Top-down institutions are required to coordinate the activities of the multiple participants, resolve conflicts and transfer information (Bauwens, 2017). They have at least four specific functions (Mansbridge, 2014). First, they can impose a solution (or threaten to) if local parties

cannot agree a negotiated position. Second, they can provide relatively unbiased information. Third, they can make the institutional infrastructure available to facilitate negotiations. Fourth, after parties have agreed a way forward, top-down institutions can monitor compliance.

Risk management and mitigation

The commons literature proposes two advantages of polycentricity in managing and mitigating risk (Ostrom, 1999; Andersson and Ostrom, 2008; Nelson, Howden and Smith, 2008; Stefan, 2014). The first is redundancy as a result of the duplication of functions by decision-making centres, creating a safety net which "can ensure that twice as many resources are thrown towards a particular problem" (Sovacool, 2011, p. 3833). The second is redundancy due to the existence of a functionally diverse range of institutions, including actors from the private sector and government, that may be spatially dispersed (Low *et al.*, 2003). This presence of multiple actors experimenting with different responses within a given governance environment, may provide resilience within the ecosystem (Galaz *et al.*, 2008). Indeed, the converse, for example where central governments have exercised sole authority over resource management, are more often associated with catastrophic resource collapse (Dietz, Ostrom and Stern, 2003).There may be an economic cost to creating redundancy within a polycentric governance system through duplication, but the apparent inefficiency may be outweighed by the benefit accrued from avoiding catastrophic loss (Galaz *et al.*, 2008).

Although the literature around polycentricity and governance has been established for several decades, much of the scholarship has been conceptual. Bauwens (2017) identifies some environmental contexts in which the perspective has been applied, including to water (Marshall, Taylor and Connell, 2013; Pahl-Wostl and Knieper, 2014), forest resource management (Nagendra and Ostrom, 2012) and energy. (Bauwens, 2017) applies a polycentric framing to energy systems and community based initiatives, but there has been little explicit focus in the literature on polycentric governance systems and Africa's energy transition. In particular, the function of polycentricity in moving from state-owned monopoly utilities to market driven investments in solar PV, has not been explored. Relatedly, can the benefits that commons scholars propose derive from polycentric governance systems be examined empirically, based on a study of solar adoption and diffusion in Africa? These are the research questions that form the basis of this paper.

Polycentric governance and energy

Energy systems can be conceptualised as both socio-technical (Sovacool, D'Agostino and Jain Bambawale, 2011; Ulsrud *et al.*, 2015; Ockwell and Byrne, 2016) and social-ecological (Ostrom, 2009; McGinnis and Ostrom, 2014; Bauwens, 2017); interacting with institutions, societal actors and organisations through formal and informal rules (Ostrom, 2005). The resilience of these systems is described in terms of their capacity to maintain interactional function despite changes in their operating environment (Carlson and Doyle, 2002; Walker *et al.*, 2004). Such changes might include a transition from state-directed electricity provision to market-driven, technologically progressive models. Resilience might be undermined by various socio-institutional barriers (Bauwens, 2017) including the lack of adaptive capacity, and the presence of strong vested interests that prefer the status quo to be maintained. From a governance perspective, energy can also be characterised as vertically and horizontally complex, with high entailed costs and strong path dependency (Goldthau and Sovacool, 2012).

The governance challenge of the energy transition in Africa can also be understood in terms of lock-in (or 'stickiness'); as well as scale. In terms of lock-in, (Arthur, 1989) proposes that once a particular technology becomes embedded, regulations become set and policy choices are solidified, leading to the development of lasting arrangements and the emergence of vested

interests that may become resistant to change. This has been observed in the (West) German nuclear energy sector (Keck, 1980a) and I suggest that similar attributes can be seen within monocentric energy systems that are embedded in many countries in Africa today. They provide a contextual backdrop of the challenges that new technologies might face in terms of adoption, even where certain benefits of a new approach are incontrovertible (for example in lowering carbon emissions).

Equally, as (Goldthau, 2014) observes, lock-in is not necessarily a bad thing. Benefits might include capacity building and the entrenchment of know-how, economies of scale that lead to overall reductions in cost, and the operational experience that provides an organic capability to manage a degree of uncertainty. However, a locked-in approach can generally only deliver an incremental response to fundamental changes in the operating environment. As will be observed in the next section, this presents a major problem in the African context. Incremental changes tend to foster a 'make do and mend' culture, particularly when the sunk costs of extant systems are high, while human and financial capital are in short supply. The result is to persevere with outlived technologies and suboptimal processes, along with the institutional apparatus necessary to maintain them.

Second, in terms of scale, energy infrastructure operates – often simultaneously – at multiple scalar environments, each with heterogeneous governance arrangements and different institutional actors. This is not, of course, to say that there are big infrastructure governance challenges at every scale of operation. For example, in the case of pico solar products, solar home systems and other emerging decentralised arrangements involving production and storage, one objective may actually be to simplify the governance structure and reduce dependence on a centralised system. In these instances, the diffusion challenges may be rather different. However, the economies of scale that are necessary for solar PV to make a meaningful contribution to economic productivity and reducing inequality in Africa, mean that effective governance arrangements are likely necessary at local, municipal, national and regional scales (Goldthau, 2014).

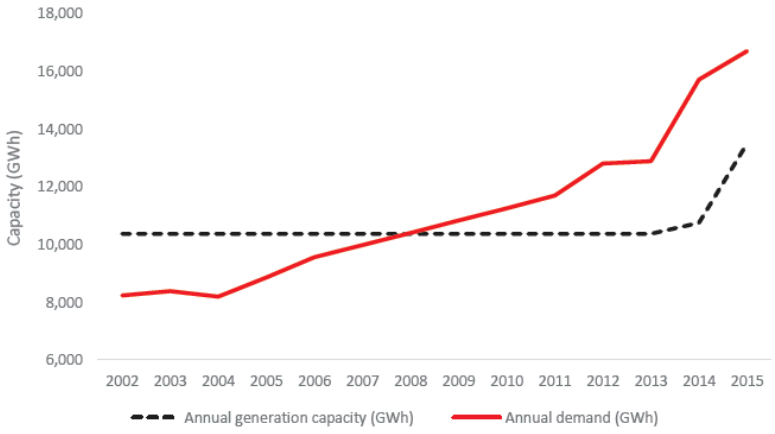
A more detailed discussion around some of these scalar arrangements, specifically in the context of Zambia, follows later in this paper. But by way of summary example, energy transition models at the local or municipal scale may involve the use of feed-in tariffs, while models at the municipal or national scale may involve reverse auctions. At the regional scale, specific mechanisms are needed to participate in power pooling. Each unit of scale has its own social-ecological complexities, to which monocentric governance arrangements that are prevalent in many African contexts – a legacy of socio-technological lock-in – are simply incapable of responding effectively, in the face of fundamental change.

Zambia's electricity sector

Electricity in Zambia is principally supplied by the Zambia Electricity Supply Corporation (ZESCO), a vertically integrated state-owned corporation involved in the generation, transmission and distribution of electricity. Around 90% of generation comes from hydropower, leaving the country acutely vulnerable to hydrological variability. There is extensive literature proposing that such variability will become more pronounced over time (see e.g. Vorosmarty *et al.*, 2000) and indeed modelled analyses of the Zambezi basin suggest that HEP output could decline by up to 20% in a drying climate, with significant consequential increases in energy costs and carbon emissions (Spalding-Fecher *et al.*, 2016).

Annual demand for electricity has risen steadily over the past decade, mirroring patterns of national economic growth. However, there had been almost no increase in supply for nearly forty years due to historic overcapacity. Indeed, for many years Zambia was a net exporter of electricity to neighbouring countries and South Africa. The emergence of China as an industrial powerhouse from the late 1990s spurred a resurgence in the Zambian mining sector, due to increased demand for copper and other commodities.

Fig 1. Generation capacity and demand

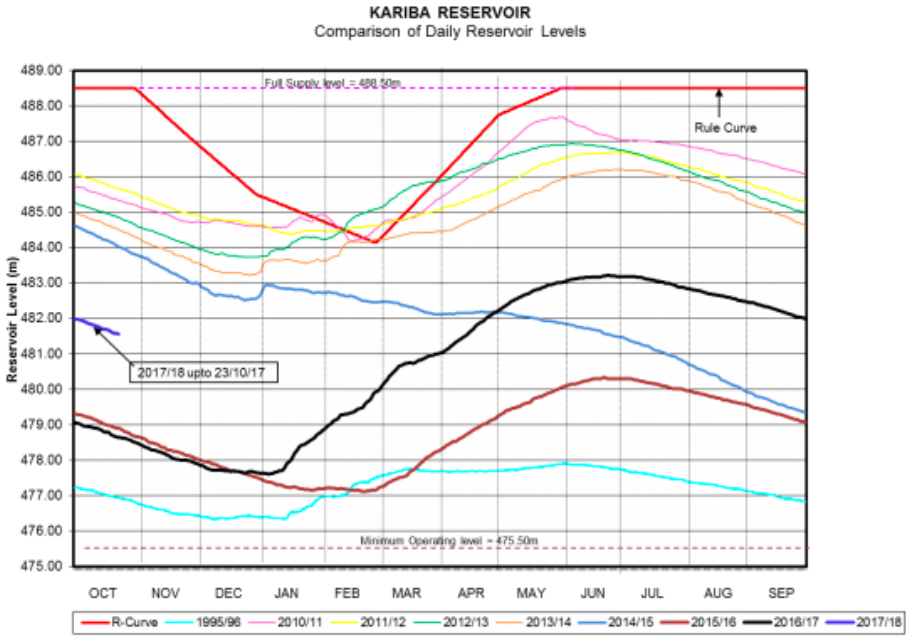


Source: ZESCO and World Bank staff calculations

ZESCO's biggest customer in terms of consumption is the mining sector. Much of the sector receives electricity through long-term power supply arrangements with the Copperbelt Energy Corporation (CEC), matched to a bulk supply agreement between CEC and ZESCO. A small amount of electricity (around 15% of installed capacity) is provided by independent power producers. The sector is overseen by the Ministry of Energy, while an independent regulatory agency, the Energy Regulation Board (ERB), is responsible for licencing and tariff setting. Overall the model is highly integrated and can be described as monocentric in terms of its governance structure and institutional framework. Meanwhile a heavy reliance on HEP is consistent with many of the attributes of technological lock-in as described in the literature (Keck, 1980b; Goldthau, 2014).

The seasonal rainfall received across parts of Southern Africa, including Zambia, over 2014/15 was significantly below the long term annual average (World Food Programme, 2016), and compounded by the effects of the El Nino weather phenomenon. A combination of reduced rainfall and increased abstraction resulted in the water levels at the Kariba reservoir reaching 20-year low levels by June 2015. As a consequence, HEP generating capacity had fallen sharply by 2015, with a shortfall against demand of more than 30% (Engineering Institution of Zambia, 2015). In July ZESCO increased the rate of load shedding (i.e. rolling blackouts) for residential and commercial customers to at least 8 hours per day. This was unprecedented in a country that for decades had excess electricity capacity, albeit at low electrification rates.

Fig. 2 Comparison of Reservoir Levels at Kariba Dam



Source: Zambezi River Authority

The consequence of this power crisis to the Zambian economy was swift and significant. GDP growth for 2015 fell below 4% for the first time since 1998. Activities in the mining sector, a key source of employment, were scaled back due to a combination of rising costs and low copper prices. Lower export earnings contributed to a sharp depreciation in the exchange rate, hiking the cost of imports, including electricity. By the end of 2015, year on year inflation was running at 20%, compared to less than 8% in the previous year. Second order consequences of load shedding included the restricted functioning of water infrastructure, thereby affecting many more people than those with direct electricity access. From a political perspective, the scope for escalation rendered the status quo as a non-viable option.

On August 13th 2015, under the directive of President Lungu, Zambia's Industrial Development Corporation (IDC) signed a memorandum of agreement with the International Finance Corporation (IFC), part of the World Bank Group, to target and develop "at least 600 MW of solar power in the shortest possible time to redress the current power deficit the country is currently facing" (IDC, 2016). At the time of the announcement, the run-rate of Zambia's power deficit was roughly 600 MW. A new institutional actor within Zambia's energy sector, the IDC was established in 2014 as a government-owned portfolio management company with a mandate "to play a catalytic role in deepening and supporting Zambia's industrialisation capacity to promote job creation and domestic wealth formation across key economic sectors" (IDC, 2016). Following its incorporation, over 30 state-owned enterprises including ZESCO were transferred to the IDC's ownership. While the roles of Ministry of Energy, ERB, IDC and ZESCO have been respectively defined as policy maker, regulator, shareholder, and operator, the boundaries of these roles remain unclear. In November 2016 the ZESCO Board of Directors was dissolved: IDC is expected to appoint the new board, which would facilitate high level decision making; but this has yet to happen.

There is also some residual ambiguity on how the Zambian government will carry out large-scale solar PV procurement. Despite the memorandum of agreement being in place since August, the Ministry of Energy launched its own parallel process in November 2015 for the procurement of 150 MW of solar PV plants with minimum capacity of 10 MW per plant. The initiation of two parallel procurements aimed at achieving similar outcomes by two different

government agencies caused consternation within the IFC, and was followed by a frenetic round of negotiation. The issue took over 6 months to be resolved, but in July 2016 the Ministry of Energy issued a statement clarifying that IDC would be responsible for large-scale solar PV procurement, while the Ministry would procure a total of 50 MW under a Renewable Energy Feed in Tariff (REFit) program.

In summary, Zambia's energy sector can reasonably be characterised as hydro-hegemonic, with HEP accounting for over 90% of current generation. The status quo, established since the country's independence and subsequently entrenched over decades of structural overcapacity, has resulted in a high level of lock-in to technical and institutional arrangements that are optimised for hydroelectric power, often to the exclusion of alternate sources. The has presented the sector with increasing vulnerability to climate variability, while burgeoning demand has meant that instead of overcapacity, the country now needs to import electricity from her neighbours. The extent of Zambia's overall vulnerability was made evident during the 2015 energy crisis, where there was a sharp deterioration in the country's economic and social performance indicators. In response, the government signed a memorandum of understanding with the IFC to develop utility-scale capacity from solar PV. The programme is called Scaling Solar, and is described in the next section.

Scaling Solar

Scaling Solar is a new procurement programme for solar PV projects, developed by the World Bank Group (WBG). Operational since 2016, it is designed to address utility-scale solar project development challenges in emerging markets through a transparent auction overseen by the IFC, with pre-screened project sites and standardized contracts. Its aim is to support the procurement of utility-scale solar PV projects through a one-stop shop for turnkey advisory and due diligence, as well as standardized contracts that can be used by any government, bidder or bank. The stated ambition of Scaling Solar is to "make privately funded grid-connected solar projects operational within two years and at competitive tariffs. When implemented across multiple countries, the program will create a new "regional market for solar investment" (WBG, 2017). Active engagements are currently underway in Zambia, Senegal, Ethiopia and Madagascar.

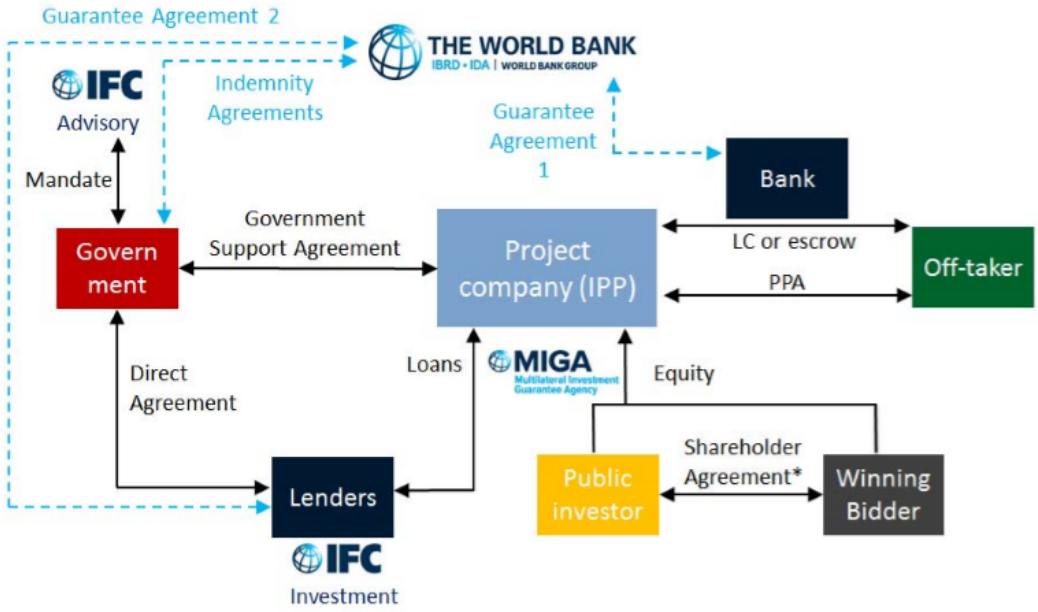
The rationale behind Scaling Solar is straightforward. Development of new utility-scale projects in many African counties face various challenges, which have made it difficult to execute bankable and competitively priced projects in the past. These challenges include a lack of transparency in procurement, utility risk, uneconomic tariffs, and – critically – the lack of a stable institutional framework with strong regulatory support. Organizations within WBG offer several support products to address some of these challenges and de-risk projects for developers, investors and governments.

There are five components to the Scaling Solar proposition: project preparation; bid preparation; tender process and award; financial close; and construction and operation. Project preparation involves technical and economic analysis to size and locate the plant, along with a site investigation, as well as regulatory and legal analysis. Bid preparation involves developing localised templated tender and project documents, along with stapled financing, insurance and credit enhancements. The tender process and award involves a request for qualification, bidder consultation, a request for proposals, review and award. Qualified developers bid for projects via a reverse auction: the lowest bidder is awarded the project. Financial close involves finalising equipment, construction and operational contracts, project approvals, final loan

agreements, insurance and risk management. The process ends with construction, commissioning and operation.

The Scaling Solar programme is targeted towards markets with a high perceived risk for the private sector. The programme describes a typical market as having the following characteristics: a) single-buyer electricity supply industry structure; b) low credit quality off-takers; c) governments with limited institutional capacity; and d) non-existent, limited or poor track record with Independent Power Producers (The World Bank, 2017). Scaling Solar's contractual framework is designed to address the single buyer context with appropriate risk allocation and government support to back-stop credit risks. By using standardised documentation, the programme's explicit aim is to make it easier for governments to adopt the project framework and achieve speedy implementation: "Scaling Solar aims to start delivering energy within a two-year timeframe from initial government engagement" (The World Bank, 2017 p. 32). In the context of Zambia's history of building generating capacity, this is a remarkably short implementation period. After the completion of the Kariba North Bank hydroelectric power station in 1977, the next new generation capacity – an extension to the North Bank plant - was only commissioned in 2014. Given the backdrop of the energy crisis, it can be speculated that the key attraction of the Scaling Solar programme to the Zambian government is this rapid implementation timeline. At any rate, in August 2015 Zambia became the first market to adopt the Scaling Solar programme.

Figure 3: Scaling Solar Structure

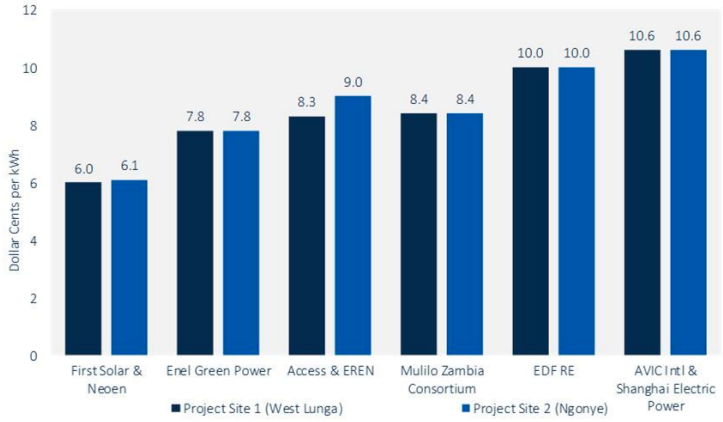


Source: The World Bank, 2017

Once the agreement was signed to develop two solar PV plants of up to 50 MW each, a suitable site was needed. For the selection process, ZESCO first identified six towns across its network which it deemed to have daily load profiles that were most suitable for solar PV supply. Based on this identification, IDC indicated that potentially suitable land was available within a multi-facility economic zone near Lusaka. The site was assessed for suitability by the IFC, and a yield analysis was completed.

The IDC then conducted a tender, with IFC support, to private sector developers. Forty-eight companies submitted a Request for Qualification, and of these, IDC pre-qualified eleven. Seven finally submitted offers and having met technical and legal criteria, bids at the reverse auction were then evaluated solely on price. The IDC awarded the bid in May 2016, just nine months after the mandate signature. Two winning bidders were announced: Neon/First Solar with 47.5MW (US$c 6.02/kWh) and ENEL Green Power with 34MW (US$c 7.84/kWh). At the time of their announcement, these were some of the lowest utility-scale solar PV tariffs in the world. This was widely regarded as remarkable development, given that Zambia's energy crisis was at its peak less than twelve months previously. Although the Neon/ First Solar bid was the lowest for both project sites, two developers were chosen; ostensibly to lower the overall operator risk associated with the programme.

Fig 4. Bids made for Scaling Solar Round 1, Zambia



(Ahlfeldt and Attia, 2017)

Following the tender process and award, the remaining stages in Scaling Solar's programme are financial close, construction and operation. Based on an IFC press release issued after the tender award, financial close was expected to be achieved within three months, leaving a further twelve months available to complete construction and commissioning (IFC, 2016) in order to meet the two year target. However as at October 2017 the first Scaling Solar project has not yet achieved financial close, some seventeen months after the tender was awarded, and two months after construction was due to be complete.

The discussion section that follows focuses on the potential for Scaling Solar and similar programmes to accelerate the diffusion of PV projects in Africa, from the perspective of a polycentric governance system. Scaling Solar was conceived as a response to the structuring challenge in African markets, through clarifying and (where necessary) creating public procurement processes; providing contractual frameworks for multiple actors; and ensuring that the rules and process for the award of contracts were seen to be transparent. By reducing frictional and structural costs in this way, it was envisaged that smaller projects, which would not normally be attractive enough to developers given the due diligence involved, would become viable. In addition, once enough small grid-connected projects were built, grid capacity would be increased and the potential for energy pooling at international and regional scale could become a reality.

It is therefore possible to characterise Scaling Solar as an adaptive governance arrangement that encourages a plurality of actors across multiple scales; driving up participation and

accountability through institutional structures that are reinforced by improved risk management and mitigation. As such, the programme is closely associated with some of the attributes of polycentricity identified earlier in this paper. However, the question at hand is whether such programmes contribute to a *system* of polycentric governance that can accelerate the diffusion of solar PV; or whether they merely manifest attributes that are associated with polycentric arrangements.

Discussion

We review some of the key attributes associated in the literature with functioning polycentric governance systems, in the context of the evolution of Zambia's electricity sector, and its engagement to date with solar PV. The attributes are plurality; institutional diversity; accountability; scale; rules and norms; deliberation and learning; conflict resolution; and redundancy. We then briefly widen the discussion to consider implications for solar PV diffusion across the African continent.

Plurality is key to adaptive response, which is a defining characteristic of polycentricity. It can be understood in terms of the capacity for institutional innovation – distinct from the techno-economic innovation that features more commonly in the literature on solar power. Institutional innovation requires systematic iterative experimentation with organisational structures; learning from previous successes and failures; adapting existing institutions to ensure fitness of purpose; and where necessary, creating new institutions to bridge the gaps that emerge during a fundamental transition. In Zambia, the Industrial Development Corporation (IDC), which was only created in 2014, has been functionally transformed through Scaling Solar. Having been established to act as a holding company for 30+ state owned enterprises (SOEs), the IDCs scope to operate was initially somewhat unclear – not least because many of the SOEs had offered power, prestige and patronage to the government departments under which they had previously operated. In principle, the IDC existed to provide operational oversight on the SOE portfolio, to "allow government line ministries to focus on policy development and implementation" (The World Bank, 2017 p. 40). In practice, many SOEs had been bequeathed with reluctance, and the relationship between the IDC, various government officials and the managers of the SOEs, frequently reflected this complexity.

With the signing of the Scaling Solar MOU, the IDC was catapulted from a somewhat removed oversight and monitoring function, to direct responsibility for the competitive procurement of solar PV power on behalf of the Zambian government. Moreover, as a co-sponsor the IDC also carries a 20% equity interest in the project, with the attendant power and responsibilities that this entails. Taken together these represent a significant change in the IDCs institutional functions, consistent with the innovative and adaptive response described in the polycentric governance literature. It should be noted in passing that in the course of this transformation, the senior management team at the IDC also changed.

Institutional diversity is a core condition of polycentric governance, as it enables experimentation and iteration. A key premise of Scaling Solar is to leverage institutional diversity within a coherent system, by bringing together a suite of World Bank Group services and instruments to finance and deliver utility-scale solar under a single engagement for the first time. The Zambian government has actively engaged with this diversity through an evolving relationship with both IFC Advisory (representing the interests of governments) and IFC Investment (representing the interests of private parties). The IFC plays a unique role within the Scaling Solar ontology: the Advisory arm is involved in developing and managing the

organisational framework, while the Investment arm provides concessionary finance and other support services to the developers. In other circumstances these dualities might be incompatible; but because the institutional function is set out transparently (and because there is broad agreement that the project would otherwise be too risky to attract private sector developers) the question of conflicted interest arose in interviews with stakeholders. Institutional diversity is also apparent in the roles and responsibilities performed by government agencies other than the IDC. The Ministry of Finance is responsible for entering into support and indemnity agreements with key partners; The Ministry of Energy provides policy direction on the procurement of PV generating capacity and ZESCO enters into power purchase agreements with the developers. Meanwhile, the ERB serves as regulator, while the Zambia Environmental Management Agency (ZEMA) assesses the environmental and social impact. This diversity of institutional actors, allows for the production of knowledge and the development of precedent through multiple, nested centres of semi-autonomous decision making. While this is certainly not without its challenges – decisions that need to be made and approved by several different government agencies are more likely to be afflicted by principal-agent problems and other obstacles – the benefit is that there is less risk of regulatory capture by a single agency or at a specific scale.

Minimising the risk of regulatory capture, links to the broader criterion of stakeholder accountability. Multiple government agencies with overlapping jurisdictions are more able to expose decisions made by other departments to a higher level of scrutiny. Some critics of Scaling Solar suggest that the process could encourage prevarication amongst agencies, who do not see any upside for themselves from this increased accountability for the decisions that they make. Certainly, rivalries between government departments are not a new phenomenon, in Africa or indeed anywhere else in the world. Inasmuch as the delay in achieving financial close on the first Scaling Solar project is due to officials dragging their feet, the polycentric governance functions are clearly not yet optimised. However, the advantage of this system of scrutiny is that it should become clear relatively quickly where the delays are, and with sufficient political momentum to surmount obstacles, the challenges should be overcome. Given the support that Scaling Solar has from the most senior level of government, it seems likely that this momentum does exist. And moreover, if the overall result is a more deliberative process which takes longer than it would though a single decision-making centre, but there is greater accountability in the results, then the delay may seem justifiable, particularly at the pilot stage of a programme.

Greater accountability is also derived from the institutional process. As Scaling Solar mandates the use of stapled (i.e. standardised) documentation for legal, technical and financial contracts, it curtails the scope for rent-seeking from opportunistic elements that are often associated with public sector procurement. In the first instance, bidders are required to submit a request for qualification, with only those who are pre-qualified being able to submit to a full bid. Pre-qualification involved an assessment of each bidders technical, financial and legal background. During the first round of Scaling Solar, this process eliminated nearly 80% of the field, with only 11 of the 48 submissions being pre-qualified by the IDC. Subsequent stages required prospective bidders to submit comprehensive evidence of their ability to undertake the project, while the final stage – pricing via a reverse auction – was conducted through sealed bids. Multiple bidders, several qualification stages and a number of assessment criteria as part of the process, all combined to increase overall accountability, which ultimately resulted in a highly competitive bidding process.

The literature proposes that a key attribute of polycentric governance systems is that they operate at multiple levels of scale, with the advantage that it engages greater levels of

participation and interest, including from local actors. Zambia's history of electricity generation has been described in this paper as hydro-hegemonic - involving a few, large-scale HEP plants, principally operated by the state-owned utility, ZESCO. This arrangement can be understood as operating a unitary scale – although a number of actors are involved, key decisions around generation, transmission and distribution are largely made at the scale of operating a single centralised system. While there have been changes to that system over the years, such as the introduction of Independent Power Producers (IPPs), the structure and operating scale has remained broadly constant, enabling ZESCO to rely on its historic knowledge. However, Scaling Solar fundamentally changes this dynamic, by envisaging the connection of several decentralised generating plants to the grid. In addition to the technical challenges of this arrangement, it also requires engaging with environmental, social and governance institutions at a local scale. The range of issues is extensive – from land rights to site-specific geotechnical factors, through to health and safety – many of which need to be addressed at the local scale. The nature of engagement has also changed – while ZESCO is the off-taker, the solar PV plants are owned and operated by the developers, who in turn bring in other contractors to work on site. The involvement of multiple parties at this local scale has been identified as one of the reasons why the project has taken longer to reach financial close. However, it might be argued that delays notwithstanding, having a higher level of participation with local actors will strengthen the perceived legitimacy of the process, and ultimately accelerate the rate of PV diffusion in subsequent rounds. Scaling Solar has been designed to operate at nested scales; from local grids through national transmission to regional power pools. It is still too early in the programme's life to comment definitively on this objective, but the engagement of local actors at this stage is consistent with the advantages of multiple scale in the literature on polycentric governance.

Rules and norms naturally play a core role in any governance system. The polycentric governance literature posits the advantages of a 'Goldilocks' framework, where the structure is sufficiently rigorous to ensure compliance, while being sufficiently accommodating to encourage innovation and iteration. In the case of Scaling Solar, key documentation such as the Power Purchase Agreements (PPAs) that developers sign with the off-taker, are structured as non-negotiable. This provides a level playing field for bidders, and helps to minimise the risk of institutional capture by vested interests that might be more experienced at negotiating PPAs within a developing country context, for example. Rigour in the bidding framework is also evidenced by the requirement to pre-qualify, and the reverse auction structure. Equally, the process has been designed to provide some flexibility. For example, developers are not locked in to using the IFC's lending facilities to fund the project, but can arrange finance through other providers. In principle at least, this opens the prospect of local banks and other sources of non-concessionary finance becoming more involved in financing Africa's energy transition, which would be a welcome development.

However, some of aspects of the rules structure have been critiqued. For example, Zambia's 'grid code' – which specifies the technical parameters for generators to connect to the distribution network – has changed little over the decades since it was first written. Its requirements are much more appropriate for hydroelectric power stations with 400 MW of generative capacity than they are for solar PV plants with 40 MW of capacity. The grid code requirements have contributed to the delays incurred by the Scaling Solar programme, in part due to what may be superfluous technical requirements. However, there are institutional protocols in place that allow for modifications to the grid code, and over time it is to be expected that the rules will adapt to the multiple scales of the solar PV programme. To the extent that this happens relatively quickly, it will reflect well upon the adaptive capacities of a polycentric governance system.

Commons scholars emphasise the necessity of processes for deliberation and learning, in order to maintain a self-organising system. The Scaling Solar programme variously embeds these processes, for example through a system of multiple bidding rounds. A total of 600 MW of capacity is due to be developed under Scaling Solar. In Round 1 tenders were accepted on two projects, each of up to 50 MW of capacity. In Round 2, announced earlier in 2017, it is anticipated that tenders will be accepted on an additional 160 MW of capacity, meaning that there may be several more rounds to come. Each round provides opportunities for deliberation and learning by various parties. On the procurer and off-taker side, experiences from the previous round should feed into the design process, for example to resolve any ambiguities in the documentation. On the developer and bidder side, the results from the previous round along with the feedback received, should help to refine the engagement process in future rounds. The evidence to date is supportive: at the start of Round 2, the organisers convened a public forum at which developers could meet the procurers and ask questions about the process. In this way, progress towards a platform of best practice is made both iteratively and transparently. Documentation is updated and learnings are consolidated systematically, rather than through a process of trial and error.

Perhaps the most important requirement for a functional polycentric governance system is an effective mechanism for conflict resolution. Given the inherently transactional nature of the Scaling Solar programme, conflicting interests amongst the various parties are all but assured. The off-taker is seeking to pay the developer as little as possible for the electricity they buy, while the developer is in the converse position. World Bank guarantees, as well as stapled documentation, are provided to lower transaction costs, while a reverse auction is designed to deliver competitive bids. The benefit of these arrangements to the off-taker appears to be reflected in the low prices achieved at the bidding stage. However, the delays since then in reaching financial close are indicative of the conflicts between stakeholders in this process, and the challenges that exist in resolving them. The literature emphasises the benefits of having both formal and informal mechanisms available to resolve conflicts. Scaling Solar convenes a broad array of parties, creating a layered and interactive dynamic that operates both through formal negotiation and informal dialogue. Scale and context plays a large role too – in Zambia's capital city of Lusaka, there are relatively few domestic networking events within the energy sector, meaning that representatives of most stakeholder groups meet each other occasionally. While informal engagement through such events has probably helped reduce information asymmetries, it is also possible that a dearth of formal conflict resolution mechanisms – this is the first Scaling Solar project to take place anywhere – has led to an over-reliance on informal approaches.

Institutional fitness is a complex requirement of polycentric governance. The literature emphasises the importance of decision-making at different hierarchical levels, alignment with the interests and values of different actors within the system, and institutional heterogeneity at different scales across multiple regions. As part of its national development strategy, the Zambian government set ambitious electrification targets of 90% for urban and peri-urban areas, and 51% for rural areas, by 2030 (GRZ, 2006). Current estimates of urban access are 60%, while rural access is at just 4% (SE4All, 2017), reflecting the scale of the task. Meanwhile in its Seventh National Development Plan (GRZ, 2017) covering the period 2017-2021, the government states that it "is necessary to promote investment in hydro, nuclear, geothermal, wind and solar energy generation". The inclusion of nuclear is perhaps surprising given there is no existing capability, but the energy programmes proposed under the various strategy objectives are very generic. This may be appropriate for a high-level plan but it raises the question as to whether there is appropriate institutional congruity between national strategic objectives, and the multiple decision-making units that will need to be engaged if a

development plan is to be successfully prospected. The plan does not state, for example, any targets regarding the mix of generation sources, nor indeed does it state any explicit targets for increasing generating capacity. Given that the plan frequently emphasises the necessity of investment from beyond the public sector if its objectives are to be met, there could be better alignment between the interests and values of different actors within the system. In fact, the broader lack of specificity over national energy plans is notable for the contrast to the explicit and published guidance on Scaling Solar, where a target of 600 MW of capacity has been set out. To resolve the challenge of improving access to electricity in rural areas, decision-making bodies from the public, private and third sectors will all need to be engaged across various tiers of the governance system, and in multiple jurisdictions. Experiences of solar PV diffusion in peri-urban and rural environments elsewhere in Africa, suggest that there is considerable scope for pico solar products, solar home systems and mini-grids (Hansen, Pedersen and Nygaard, 2015). Attempts at progress are being made, for example through the Renewable Energy Feed in Tariff (REFit) programme, which is supported by a range of prominent local and international actors. However, the enabling legislation has not yet been passed and so projects are still at the planning stage.

Redundancy features in the polycentric governance literature as a mechanism for managing and mitigating risk. It proposes that some duplication within the structural framework may be desirable, as the benefit of contingent protection that redundancy provides, may outweigh the cost of sub-optimal resource efficiency. It is difficult to test this proposition within the Scaling Solar programme, although attributes of redundancy are apparent. As described earlier, at least seven government-controlled agencies are directly involved in the programme, including two separate ministries. Whether this can be regarded as a risk management mechanism is debatable, particularly as the programme has yet to result in a plant being commissioned. However, a stronger case might be made for the bidding process, where having forty-eight bidders in the first instance helped to ensure that it was a strong field from the post-qualification phase onwards. It also created a competitive tension between bidders, that was reflected in the low tariffs that were secured in Round 1. Elsewhere there has been little evidence of duplication at this stage, although this could change in subsequent rounds. The IFC has stated that it anticipates non-concessionary sources of finance to advance loans to developers for future projects, and this should help to reduce the risk of insufficient investment. Also in future rounds, multiple projects may be proposed simultaneously, giving developers and others some degree of agency in terms of site selection, for example. Geotechnical issues in relation to the current site for Round 1 are believed to account for some of the delays that have been experienced, so providing a choice of sites may be an important risk mitigation mechanism for future rounds.

To conclude this discussion, we briefly consider progress to date with Scaling Solar in Zambia, in the broader context of solar PV diffusion in Africa. The focus of this paper has been on some of the political and socio-cultural dimensions of the transition, and we consolidate the points made into three statements. The first statement proposes that there are certain attributes of a polycentric governance system (as described in the academic literature), that demonstrably contribute to accelerating market-led investment in solar power. These include plurality, iterative innovation, deliberation and learning, accountability, and redundancy. The Scaling Solar programme is beginning to provide an empirical base that demonstrates what these benefits are in practice, as well as how they might be promulgated.

The second statement proposes that there are attributes of polycentric governance that make an ambiguous contribution to the process. These include diversity, scale, and rules and norms. Diversity may help to prevent regulatory capture, but it has also contributed to policy paralysis

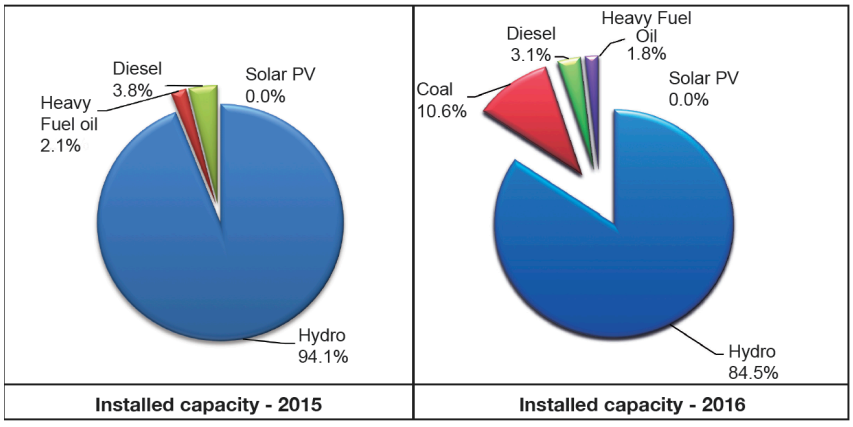
and delay. Scale is complex; the benefits of enhanced participation with local actors is both intuitively and theoretically appealing, but multi-scalar arrangements can also contribute to the seeking of economic and political rents. Rules and norms are of course a necessary component of any arrangement; however, the emphasis in the literature around flexibility and iteration is also somewhat problematic. In a transitionary environment, these arrangements can lead to ambiguity, delays and other potentially undesirable outcomes.

The third statement proposes that some of the benefits attributed to polycentric governance systems, are in fact more likely to slow down the progress of Africa's energy transition. These include conflict resolution and institutional fit. The literature emphasises the importance of informal and formal mechanisms for conflict resolution. In practice, arrangements such as these are likely to tilt rather than level the playing field, given the omnipresence of powerful vested interests, thin markets, and weak mechanisms for capacity building. And in terms of institutional fit, the literature emphasises the importance of tactical processes such as decision-making and adaptive governance, across different jurisdictions and scales. However, the biggest challenge not tactical but strategic; and can be split into two questions. First, what is the national energy plan, in terms of dates and targets? Second, is that plan achievable, based on the resources available? It is only once those two questions have been reasonably answered that the third question – how will the plan be achieved – becomes salient. Most of the extant literature on Africa's energy transition focuses on the techno-economic aspects of innovation, which rightly emphasise tactical and executional challenges. In contrast, however, political and socio-cultural dimensions that emphasise strategy over tactics remain relatively unexplored. Polycentric governance is, then, a necessary but insufficient framework for policy-makers and others to understand the prizes, perils and pitfalls in transitioning away from state and donor-driven models of development, and towards market-led investment in Africa's solar power opportunity.

Conclusion

2016 was an important year for Zambia's energy sector, as it brought the biggest change in the country's mix of generating capacity since the country's independence in 1964. This can be seen in Fig 5:

Fig 5. National Installed Power Generation Capacity by Technology 2015-16



(ERB, 2016)

Installed capacity increased by 17% over the previous year in 2016, largely due to the commissioning of a thermal coal power plant in southern Zambia (ERB, 2016). While it is not

within the scope of this paper to comment on the desirability or otherwise of introducing fossil fuels to the country's energy mix, it should be noted that coal does not feature in this way within the Seventh National Development Plan. Perhaps more poignantly, the share of solar PV within the generation mix remains at or near zero percent.

The point to be made here is not one of pessimism or despair but rather to recognise that the pace of the transition to reliable, sustainable, modern energy in Africa is likely to lag the rate of innovation and technical progress that is commonly associated with the literature on solar PV diffusion. This paper has proposed that that there are socio-cultural and political advantages that uniquely accrue to a functioning polycentric governance system; which, in the context of Africa's energy transition, could materially accelerate PV diffusion. The nature of these advantages has been explored through the lens of Scaling Solar, a new programme developed by the World Bank, in the context of Zambia's energy sector. Findings to date suggest that while some of the advantages ascribed to polycentric governance systems in the literature can indeed support the transition, other purported advantages are more nuanced in practice. Of overarching importance for policy making is the distinction between strategy i.e. what is the plan, and is it achievable; and tactics i.e. how will it be achieved. It is to this latter end that the advantages of polycentric governance systems are manifest – but the fact remains that in the absence of a strategic plan to prosecute, even the most highly functional polycentric system will lack direction and momentum.

In trying to understand the driving forces for market-led investment in solar power, arguably too much emphasis is currently placed by policy makers, agencies, investors, practitioners and others on this tactical element of how the transition will be achieved. Conversely, too little emphasis is being placed on the plan itself, and its achievability. Africa's energy transition will ultimately depend on a synthesis of strategy and tactics within a framework of polycentric governance, if the changes are to be swift, successful and enduring. Progress to date provides strong grounds for optimism, if the lessons being offered can be learned.

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