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# EXPLORING THE GOVERNANCE OF PRIVATE FINANCE FOR THE ELECTRICITY SECTOR IN SUB-SAHARAN AFRICA

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Thesis submitted for a Doctor of Philosophy

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# *Declaration*

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree.

Signature: ……

**Julian Gregory**

# *Executive Summary*

My dissertation is a paper style thesis, which contains the following chapters: an introduction; a research design; three chapters, each derived from a different successful peer reviewed policy paper (there were corrections applied to each of the original papers); and a discussion and conclusions section. My thesis aims to answer the following research question: 'What aspects of governance deter private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa?' My methodology utilises a Hypothetico-deductive approach: which focuses on the impact of risk surrounding the private financing process, when applied to electricity infrastructure development in the sub-Saharan region. My sources for evidence are mixed and multidisciplinary; and my analysis principally applies a governance lens.

This is an important topic, as it is over 20 years since the multilateral development community re-focused its policy surrounding the improvement of electricity access in sub-Saharan Africa (SSA), to one that places private sector financing at the centre of its strategy (which transpired during the leadership of the World Bank by James Wolfensohn in the 1990s). Yet according to a recently published report by the IEA: 'despite being home to 17% of the world's population, Africa currently accounts for just 4% of global power supply investment' – suggesting a significant policy failure for over twenty years.

With SSA's population forecast to double by the UN by 2050, it is imperative that the development community understands why such a policy is gaining so little traction. Affordable and reliable energy access is crucial for the economic growth that such a rapid population increase will require. If it is not delivered, excessive environmental damage will otherwise occur, as the enlarging population will have to continue to rely on unsustainably biofuel sources for its energy needs (mostly wood – causing deforestation); and ever increasing social problems will ensue, due to accelerating competition for scarce resources by this ever-growing population.

My first paper has two functions: firstly, to reformulate the relevance of risk within the academic research community as an obstruction to the private financing of new SSA electricity infrastructure development. Secondly, to confirm and classify those risks that can be found in the greater interdisciplinary literature, which would negatively influence a private, financier's willingness to invest in this type of infrastructure. To do this, I firstly analysed a manageable five-year sample of literature surrounding three African countries with a notable body of academic literature: Kenya, Mozambique, and Tanzania. To create

my sample, I systematically interrogated the two principle academic libraries of Scopus and the Web of Science, using key terms. My secondary analysis then digs deeper, by including further interdisciplinary literature not specific to the first sample, drawing from the Project Management, Finance, and Innovation academic disciplines – to identify and classify all relevant and likely risks.

My second paper is theoretical and utilises three separate perspectives to deliver a holistic and inclusive governance picture, to answer the following research question: 'What aspects of governance deter private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa?' These perspectives comprise: 1) Financial Investment Governance**,** the private sector investor's perspective, which focuses on the rules and institutions (or lack of) that directly influence the financial investment environment in SSA. 2) Political Governance, the political economy perspective, which relate to the negative, indirect investment consequences resulting from the way that SSA governments govern; and 3) Technical System Governance, a 'systems' perspective, which encompasses how the standard structure and organisation of the wider electricity delivery system in each country in SSA, negatively impacts such investment.

My third paper focuses on the impact of governance surrounding large-scale electricity infrastructure development (megaprojects), by empirically analysing six case studies located in South Africa. My guide for my fieldwork was the following research question: 'What aspects of project governance are important, to prevent time delays and cost overruns, when building large scale electricity infrastructure in South Africa?' This research question is relevant to my thesis' primary interrogation theme, as the adherence to schedules and budgets are of central importance to successful private financing of such infrastructure.

My discussion and conclusions section commences with an explanation for why the multilateral development community should persevere with their policy of promoting private financing of electricity infrastructure development, in SSA. I do this by first explaining why access to affordable and reliable electricity services in Africa is crucial for promoting the meaningful economic growth in the region. I then discuss why the alternatives to this policy, are less inclusive and more exploitive. I then use this positioning to frame my key findings from my research, which I then clarify. Finally, I discuss policy implications surrounding my findings and possible policy solutions.

# *Acknowledgements*

Firstly, I would like to thank my two supervisors, Prof. Benjamin Sovacool and Prof. Paul Nightingale, for their invaluable help and direction through this most unique and challenging of journeys. Their faith in my ability to complete and submit this PhD thesis (along with their support and direction), were crucial for creating the necessary ongoing enthusiasm for concluding such an undertaking. I would particularly like to thank Paul, for facilitating important aspects concerning the financing of this journey – without which I am certain, the journey would never have been possible for me to complete. Ben also deserves special mention, for sharing his expertise in navigating the academic publishing process and helping to finance important aspects of my fieldwork in South Africa. Further, thankyou Ben for ensuring I completed this PHD in the time that I did, which I understand may be a SPRU record. As I am a very mature and financially challenged research student, my speed ensured that other hurdles did not defeat me in my PhD endeavour. **I will always be grateful to them both for making what appeared impossible, possible for me.**

I must also furnish special thanks on Prof. Samuel Kamuriwo of Cass Business School, who shared his contextual knowledge of Africa during fieldwork in South Africa, whilst working together on an associated research project financed by the British Academy. He also helped me adapt my interview techniques from a commercial approach to an academic one, by making me aware of my propensity to lead witnesses during research interviews, and therefore potentially corrupting their evidence with subjective opinions. I believe my interview technique has much improved due to his advice.

I would also like to acknowledge all my other colleagues in SPRU, for helping me at various points on this journey: particularly Prof. Martin Bell and those with an African electricity focus: Blanche, Chantal, and Sandra. You were all important, for numerous reasons, and all played your part in making this degree attainable. I must also recognise my good friend Garth Williams, who I met through SPRU – it is always useful to have a friend and confidant in Africa, when you are carrying out African orientated research.

Finally, I would like to give special thanks to my partner, Stephanie Watson – who appeared in my life as this journey commenced, and ultimately is the reason I completed it. Her tolerance and support through the low points, stopped me quitting on several occasions; and her sense and practicality brought me back to the ‘real world’, when the highs disconnected me from reality.

# *Declaration of previously published work*

(including levels of contribution)

This thesis includes the following published works:

**Published Work 1** – Forming Chapter 3 of this thesis:

**"The financial risks and barriers to electricity infrastructure in Kenya, Tanzania, and Mozambique: A critical and systematic review of the academic literature"**

Co-authored with Professor Benjamin Sovacool
(SPRU & Aarhus University, Denmark)

Published in **Energy Policy 125** (2019); pages 145-153

As a co-authored paper: Professor Ben Sovacool determined the paper's methodology, in consultation with me. I carried out the research (a systematic review); and I wrote most of the content, with an editorial overview by Ben. Ben suggested the paper's title and was particularly helpful with the signposting within the paper, such as the paper's headings and sub-headings. Ben was especially helpful with responding to the peer review process, ensuring that I understood how to carry out this task effectively for future practice.

The systematic review commenced with 815 academic papers. From these, I initially deemed 116 were relevant when I measured them against the paper's research question: 'What are the different types of risks obstructing private sector financing of electricity infrastructure in Kenya, Tanzania, and Mozambique; and how and why they are significant?' I then reviewed each paper in full. After reading all 116 papers and evaluating the content in detail against the research question, I then rejected a further 15 as not being relevant – leaving 101 papers for me to analyse and classify according to a coding schema (designed by Ben, in consultation with myself), which involved eight further questions.

I estimate that Professor Sovacool contributed between 10% and 15% of the paper's intellectual input.

**Published Work 2** – Forming Chapter 4 of this thesis:

**"Rethinking the governance of energy poverty in sub-Saharan Africa: Reviewing three academic perspectives on electricity infrastructure investment"**

Co-authored with Professor Benjamin Sovacool
(SPRU & Aarhus University, Denmark)

Published in **Renewable & Sustainable Energy Reviews 111** (2019);
Pages 344-354.

As a co-authored paper, I was the principle author and was responsible for much of the paper's content and research. We collaborated to determine the paper's conceptual approach and the paper's title. Ben added some further contributions that improved the paper – this included adding the list located in the discussion section (collated from the substance of the paper). He also helped with some editing of the finished manuscript.

I estimate that Professor Sovacool contributed up to 10% of the paper's intellectual input.

**Published Work 3** – Forming Chapter 5 of this thesis:

**"Governance, scale, and scope: reviewing six South African electricity generation infrastructure megaprojects"**

Julian Gregory

Accepted for publication in **Utilities Policy.**

This paper was sole authored by myself but was reviewed by a small number of academics (including, but not limited to my supervisors) who I have worked closely with during my PHD journey. Their collective input improved the paper.

The first ten interviews, that formed part of the empirical data for the paper, were carried out whilst I was on intermission and working on a project concerning capabilities for electricity infrastructure delivery in sub-Saharan Africa – funded by the British Academy.

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# Key Terms

AfBD ..... African Development Bank

CDM ..... Clean Development Mechanism

CRA ..... Credit Rating Agency

DAC ..... Development Assistance Committee (of the OECD)

DFI ..... Development Finance Institution

DRC ..... Democratic Republic of Congo

EPC ..... Engineering, Procurement, Construction

FDI ..... Foreign Direct Investment

GPT ..... General Purpose Technology

IEA ..... International Energy Agency

IPP ..... Independent Power Producer

OECD ..... Organisation of Economic Cooperation and Development

ODA ..... Official Development Assistance

RSA ..... Republic of South Africa

SSA ..... Sub-Saharan Africa

SDG ..... Sustainable Development Goals (UN)

SPRU ..... Science Policy Research Unit (University of Sussex)

UN ..... United Nations

# Prologue:

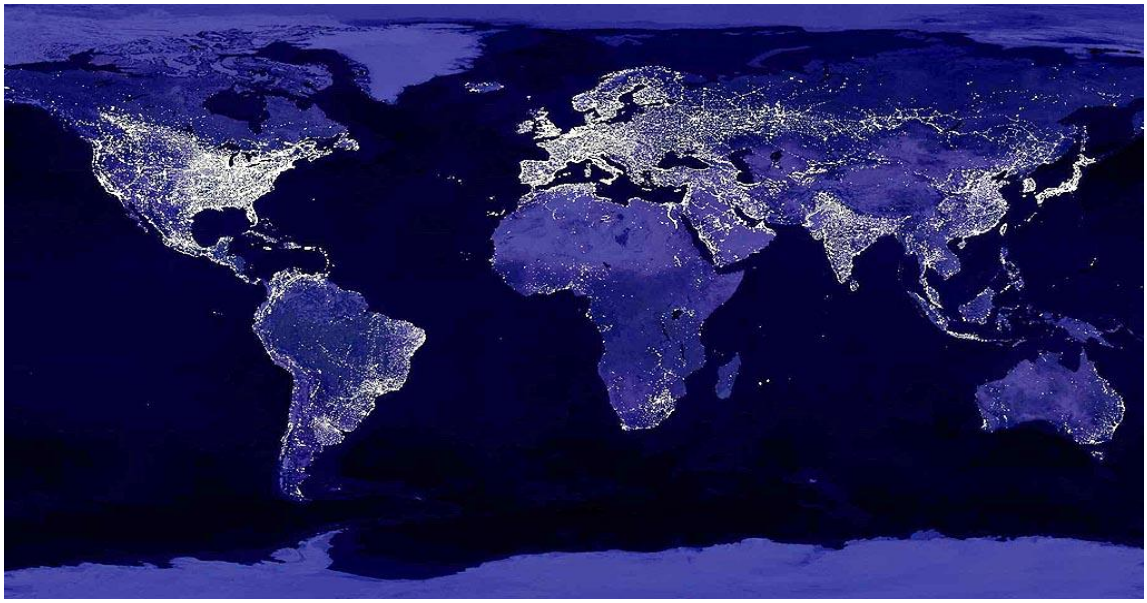
## Why I commenced this academic journey

I first stumbled across the issue of electricity poverty in sub-Saharan Africa, in 2011. When I say stumbled, this is not meant to trivialise the issue, or demean its magnitude or impact on the region – I just had zero awareness of the problem as it then existed, in any capacity; and I certainly wasn't aware that this subject was about to redefine my life.

In 2011, I was living in Australia, helping my then 12-year-old son recover from intensive medical treatment for leukaemia (he is now a healthy twenty-one-year-old) and being introspective about my life. I was at that point, working on the financing of several solar PV renewable electricity generation projects in both India and the Philippines (unsuccessfully) – which involved my working for the first time, at an authentic development/commercial intersection: between a development need and a commercial driven financing proposition. I was also becoming acutely aware of the policy problems surrounding the private financing of electricity infrastructure, in a development context. The realisation had struck, that traditional OECD approaches to the financing of infrastructure do not work well, if at all, in a development context ... Then a work-related friend asked me, if I had ever considered financing renewable electricity projects in Africa.

I now find myself being able to make a significant contribution to the body of knowledge, surrounding such an important policy development intersection – and I thank SPRU for giving me this opportunity.

Figure 1: Satellite Imagery Showing the Earth at Night, 2015



Source: U.S. National Aeronautics and Space Administration and National Oceanic and Atmospheric Administration. Composite map of the world assembled from data acquired by the Suomi NPP satellite in April and October 2015.

# *Introduction*

"*In Sub-Saharan Africa, three out of five people don't have access to electricity*."

Fatih Birol, IEA Executive Director
Ministerial Forum of the African Union Commission and the IEA
– Addis Ababa, 12 June 2019[1]

My dissertation unpacks the topic of sub-Sahara African (SSA) electricity access: specifically focussing on why the development of much needed new electricity infrastructure in the region is not being financed and built. Electricity access is problematic for the region from two perspectives. Firstly, there are the issues associated with the number of people with zero access to such an important *general-purpose technology* for contemporary societies (see sec.1.2): as 600 million sub-Saharan Africans, 80% of whom live in rural regions, do not currently have any access to electricity [Blimpo & Cosgrove-Davies, 2019; IEA, 2019]. Secondly, there is an affordability and reliability issue for those people who do have access [Ibid], which forms a market-breakdown (one of a number that surround the topic). Electricity services in Africa are the most expensive in the world, and additionally the most unreliable: "*yet tariffs are still uneconomic, contributing to this reliability challenge"* [Blimpo & Cosgrove-Davies, 2019:4]. Without a comparably efficient electricity service to other more affluent regions of the world, economic development in the sub-Sahara African region (SSA) will be significantly constrained [AfDB, 2018; Blimpo & Cosgrove-Davies, 2019; Briceño-Garmendia et al., 2008; Halff et al, 2014; IEA, 2019; Moyo, 2013].

[1] https://www.aa.com.tr/en/africa/600-million-africans-go-without-electricity-iea-chief/1502097
https://au.int/en/newsevents/20190612/auc-iea-first-ministerial-forum-future-africas-energy

This challenge is perhaps the most perplexing of international development problems currently facing the multilateral development community, as it surrounds a technology that has been well understood and utilised for over a century. It is this difficulty of resolution, in combination with the significance of the problem's many societal impacts, which has driven my desire to find a solution. I hope that this desire renders my thesis to be a significant contribution to the body of knowledge surrounding this problem.

# 1. The importance of reliable and affordable electricity services for SSA

## *1.1 Energy, electricity, and poverty*

Just as there is no clear denotation of the term poverty, there is also ambiguity surrounding what its sub-terms energy and electricity poverty convey [Sovacool, 2014]. As these concepts have significance to this thesis, I will briefly clarify what I mean by these idioms in this dissertation, and why resolving them is important from a poverty perspective.

Poverty is not just a description of a lack of income, but it also incorporates further concepts such as calorific intake, life expectancy, housing quality, literacy, access to energy, and a variety of other factors' [United Nations Development Program, 2010]. Energy too is multidimensional, and includes many configurations: such as electrical, mechanical, or thermal. When prefixed to poverty, it essentially embraces two elements: a lack of access to affordable and reliable electricity services – electricity poverty; and access to basic and unhealthy (due to pollutants) cooking fuels, such as wood, charcoal or dung [IEA et al, 2010; Sovacool, 2014a].

Electricity services are essential to the poor in many ways, not only directly, but also indirectly – as the direct enabling aspects, need little elaboration, I will just summarise some of the indirect ones. These include, being able to use labour saving appliances in the home, such as for washing or cooking, which empower women; permitting access to computers and the internet, to enable knowledge diffusion for better educational outcomes for both households and the wider society where those households are located. Electricity can also facilitate important income creation tasks, such as those offered by

light, which extends the number of usable hours in a day for creating income. Alternatively, by improving health outcomes which enhances an individual's productiveness: enabled by water pumps for upgraded sanitation; or refrigeration which both permits the storage of vaccines or improved food hygiene.

## *1.2 Electricity as an economic growth enabling technology*

Perhaps equally important, are electricity's enabling characteristics for economic growth, due to its function as a *general-purpose technology* (GPT)[2]. Through being a GPT, electricity has a central influence on both an economies efficiency and the nature in which it will grow. This is particularly important, if the sub-Saharan region is to reduce its dependence on primary resource extraction to deliver much needed economic growth. The sorts of things it enables are as diverse as facilitating foreign direct investment (FDI), which is a major constituent for improving the level of capabilities and investment within an economy – an essential ingredient for an economies convergence with their wealthier peers [Abramovitz, 1986; Ayanwale, 2007; Hobday, 1995; Markusen et al, 1999]. To the growth of a politically stabilising middle class, through the enablement and establishment of any domestically owned manufacturing industry, which is going to involve any sort of mechanisation powered by electricity [de Soysa, 2003].

With SSA's population forecast to double by the UN by 2050 [UN News], access to affordable and reliable electricity services will also be crucial for the economic growth that such a rapid population increase will require [AfDB, 2018]. Without electricity, excessive environmental damage is likely to occur all over the continent, as the expanding population will have to continue to rely on unsustainably biofuel sources for its energy needs - mostly wood, causing deforestation which can already be evidence by existing rapid deforestation within countries such as Kenya [Institute for Economic Affairs, 2015]. There will also be ever increasing social problems, followed by likely conflict, due to accelerating competition for scarce resources by this ever-growing population.

[2] **General-purpose technologies** (GPT): A technology that acts as a gatekeeper and an enabler of other important technologies, which can have a protracted aggregate positive impact, throughout an economy – through being a platform for the introduction of other innovative technologies. Such technologies perform a generic function and possess a scope for improvement, either in their own capacity or in combination with ensuing complimentary technologies [Bresnahan & Trajtenberg, 1995; Jovanovic & Rousseau, 2005].

### *1.3 Electricity's importance to successful societal development*

Electricity's GPT characteristics also makes the United Nations (UN) Sustainable Development Goal (SDG) 7 – access to affordable and clean energy – unique amongst the UNs other SDGs: as it either directly or indirectly enables the likely fulfilment of many of the other SDGs. The following SDGs would qualify as being influenced by SDG 7: 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13 and 16.

**Figure 2. The United Nations Sustainable Development goals**

(Source: news.un.org)


The rest of this section will now present a short narrative, focusing on four interrelated societal challenges for the region, which will urgently require reliable and affordable electricity services for permitting any possible aspiration for harmonious societal growth. These are of particularly significance, if the United Nations projections for the doubling of Africa's population by 2050, are realised [UN News].

**Population growth** in the sub-Saharan region is currently undergoing a *Malthusian* exponential population growth phase, where the region's level of population is in danger of uncoupling from the region's ability to support such an increase in that number of people. To support such growth without extreme conflict inevitably occurring, the region will require a 'green' or agricultural revolution to deliver increased food productivity using electricity driven irrigation; and consequentially land reform and accompanying

electricity supported **urbanisation.** Equally, such rapid urbanisation will require **industrialisation** and electricity powered economic growth, which will not be possible without electricity enabled **education**, to support the growth in necessary capabilities that will be required to help facilitate such growth. Put simply: in order to avoid a *Malthusian catastrophe*, access to affordable and reliable electricity is essential for the sub-Saharan region – and if it is not realised, this will not just be problematic for that region, but for the rest of the world due to consequential, predictable and unpredictable spillover effects.

# 2. Unpacking *electricity poverty* in SSA

The academic literature is uniform in recognising that there is a problem of poor access surrounding electricity services within SSA. In contrast, as can be observed from the results of my systematic literature review (summarised in Chapter 3, sec.4.1), this literature falls into two broad camps of causation. On the one side there are the supply-side orientated explanations, which focus on the failures of the many regional electricity service delivery systems (the utilities and surrounding institutions); and on the other, there are demand-side orientated explanations, which focus on a lack of demand due to widespread household poverty. I argue in this dissertation that both these camps of explanation are too limiting in their appreciation of the problem. They do not drill down far enough to understand the full structure of causation, behind the problem (Chapter 3).

## *2.1 Substandard systems for electricity service delivery*

This supply-side narrative of explanation suggests that electricity poverty in SSA is a consequence of an inefficient and dysfunctional utility and associated government institutions: such as regulators or relevant and responsible government ministries [Eberhard and Shkaratan, 2012; Amars et al., 2017]. Every SSA country is vulnerable to such a failure, as each one utilises a government-controlled network *hub & spoke* system, to deliver electricity services to their populations. [Blimpo & Cosgrove-Davies, 2019; IEA, 2019; UNCTAD, 2017]. This structure comprises a series of large-scale electricity generating assets, with supporting transmission and distribution networks; and is a legacy of the previous European colonial administrations, that had been in control when the technology had become widely adopted during the first half of the twentieth century.

For this network delivery system to operate successfully, it requires a utility to have a minimal level of both technological skill and dynamic tacit knowledge (capabilities) within its management structure [Bell & Pavitt, 1993; Teece et al, 1995]. Furthermore, it requires enough working capital to maintain and operate the system efficiently and effectively. These requirements are often lacking throughout the region – even to an extent in South Africa, as can be observed in Chapter 5 of this thesis.

Without adequate levels of capability, the likelihood that a utility will recover its cost of delivering electricity when it sells it becomes too uncertain, due to both technical and non-technical losses. Technical losses entail a significant loss of electricity during transmission, through a lack of maintenance of the transmission system – as high as 25% in Tanzania for example [Amars et al, 2017]; or an inability to operate effectively a demand and supply *load* management, within the network [UNCTAD, 2017]. Non-technical losses entail a significant risk that customers will not pay for the electricity they use [Eberhard & Shkaratan, 2012]: either by not paying their bills, or stealing electricity directly from the grid, or bypassing their electricity meter [Bekker et al, 2008].

Regulatory or ministerial failure generally revolve around the efficiency of commercial tariff levels – but as I have just explained, tariffs levels are not the only reason for failure of the system. It should also recognise rivalrous government needs, which can make the delivery regime 'off limits' to efficiency. An example of this might be that the government does not wish to lose control of the delivery regime, as their neo-patrimonial political system, requires control of it to facilitate a patronage system (Chapter 4, sec.5.2.5).

## *2.2 Household Poverty*

As an alternative narrative of explanation, electricity demand (kWh) is a function of varying contextual factors such as availability of resources, electrical appliance ownership, duration of usage, and the affordability of tariffs [Kowalska-Pyzalska, 2018]. Moreover, there is often a direct or at least meaningful relationship between household economic poverty and energy burdens and energy poverty: the poorer households are, the higher their energy burden, yet poorer households tend to access cheaper alternative energy options, when electricity tariffs are high – reducing demand [Sovacool, 2012; Monyei et al., 2018a, 2018b; Bohlmann and Inglesi-Lotz, 2018].

The demand-side camp therefore consists of two principle impediments: firstly, the cost of connectivity, not just delivering electricity to the front door of a household, but also the purchasing of the necessary electrical appliances to use it, and such extras as correctly 'wiring' the recipient's home to ensure safe access [Cook, 2011; IEA, 2019; Sen, 1999]. Secondly, there is the cost of the energy to be consumed – which may be further compounded by the unfamiliarity of using it wisely (turning off fans and lights when no one is home) [Ibid].

### *2.3 Why I reject these explanations as incomplete*

Whilst I of course accept that household-affordability is a very real issue for electricity access in the region. I however argue in this thesis that this explanation is too simplistic, as a deeper interrogation delivers more nuanced evidence. To help support my positioning, I refer to the following evidence.

> A *"lack of access to electricity is endemic in Africa regardless of income. The region is unique in the world in having the most countries whose level of electrification is below what their income level would predict. Africa stands out for outliers, such as Botswana, Equatorial Guinea, and Namibia, which should have significantly higher levels of electricity access given their per capita incomes. Overall, the region's average level of electricity access in 2016 could have been 60 percent, given its per capita income, instead of 43 percent"* [Blimpo & Cosgrove-Davies, 2019:12].

I also reject the supply side narratives for similar reasons: relevant as they are, they require unpacking further. The issues of relationship behind the structure of causation, needs to be better appreciated.

### *2.4 My thesis' positioning, hypothesis, and research question.*

My thesis consequentially postulates that there is an alternative explanation for electricity poverty in SSA. This explanation covers both the lack of access to electricity services, and the unreliable and expensive service that is available when access does exist. My explanation also encompasses both the supply-side and demand-side dynamics just summarised – but I treat them as part of a larger landscape of independent variables, that influence the ability to finance the construction of new electricity infrastructure. This makes the ability to finance, a dependent variable. I am arguing that electricity poverty in

SSA is as much an issue of causation as it is about the underlying challenges that impact access to electricity: what causes what to happen, rather than just a sum of everything.

My hypothesis is that the cause behind SSA electricity poverty is an inability to finance the construction of new electricity infrastructure, because of excessive and unmanageable risks – which in turn have created several types of market failures in the region (Chapter 6, sec.3). These risks then lead the private sector to reject investment opportunities associated with SSA electricity infrastructure projects, perceiving them as being both too uncertain financially and reputationally, when compared to alternative investment opportunities.

My thesis seeks to understand why this is – and to make this task more manageable, I apply a governance lens by means of asking the following research question: 'What aspects of governance deter private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa?'

# 3. Supporting evidence for the lack of infrastructure

The IEA, in their recently released Africa Energy Outlook 2019, makes a case that supports my thesis' positioning, as well as anyone:

> *"Infrastructure is an essential building block for economic development and quality of life, but Africa, especially sub-Saharan Africa, lags behind other developing economies in virtually all aspects of infrastructure quality. Over the past three decades, the level of per capita power generation capacity in sub-Saharan Africa has remained flat, whereas in India and Southeast Asia (which had less generation capacity per capita than sub-Saharan Africa in 1990) it has grown fourfold"* [IEA, 2019:32].
>
> *"Making up the deficit of energy infrastructure in Africa will require a massive ramp-up in investment, but actual spending trends have been moving in the opposite direction. Energy supply investment in sub-Saharan Africa has dropped by over 30% since 2012. {….} Power supply investment registered strong growth until 2014 but has since stalled. The one bright spot has been rising investment in solar photovoltaics (PV), which is set to surpass that in hydropower for the first time in 2019, according to early data"* [Ibid:33].
>
> *"Africa needs a significant scale-up in electricity sector investment in generation and grids, for which it currently ranks among the lowest in the world. Despite being home to 17% of the world's population, Africa currently accounts for just 4% of global power supply investment. Achieving reliable electricity supply for all would require an almost fourfold increase, to around*

> *$120 billion a year through 2040. Around half of that amount would be needed for networks"* [Ibid: 16].

The IEA is not the only multilateral organisation which is highlighting this infrastructure deficit: 'The World Bank', 'The African Development Bank', 'The Africa Development Forum', 'Africa 50', 'The International Finance Corporation', 'The Infrastructure Consortium for Africa', 'The G20', The Africa Progress Panel' and The World Economic Forum' join them in this observation, as well as many others. [AfDB, 2018; Africa Progress Panel, 2017; Africa50.com; Blimpo & Cosgrove-Davies, 2019; G20, 2017; ICA Report, 2017; IFC, 2016; World Bank 1, 2017; World Bank 2, 2017; World Bank 3, 2017; weforum.org].

# 4. The failure of the dominant multilateral policy

Towards the end of the last millennium, there was a redefining of multilateral development policy surrounding the electrification of SSA, led by the by World Bank under the presidency of James Wolfensohn [Collier, 2014; Eberhard, 2015]. This repositioning resolved that the financing for the urgently required electricity infrastructure development, had to come from the private sector: as the need for new electricity infrastructure in the SSA region represented too great a burden on traditional development approaches such as Official Development Assistance (ODA) [ICA Report, 2017; IEA, 2019; UNCTAD, 2017] .

> *"The amount of investment needed for the provision of electricity in sub-Saharan Africa is substantial and well above the level of the current flows of capital into the region's power sector. Reaching full access by 2030 and maintaining it to 2040 would require multiplying current investment levels by five. The cumulative investment in this case would reach more than $2 trillion between 2019 and 2040"* [IEA, 2019:141].

Despite this dominant policy's existence since the 1990s,

> *"The majority of the power sector investment in sub-Saharan Africa* {continues to be} *financed by public funds, mainly from domestic governments or state-owned utilities, development finance institutions (DFIs) and export credit agencies (ECAs). Of the new projects with final investment decisions in the period 2014-18, two-thirds of the new generation capacity was publicly funded"* [IEA, 2019:143].

Yet without significantly increased investment, meaningful economic growth in SSA will be impossible.

> *"Poor electricity infrastructure in low-income countries is a major cause of unreliability. Under-investment in existing transmission and distribution assets and the inability to meet peak load due to installed capacity deficit result in frequent service disruptions (unscheduled outages or regular load shedding), ranging from a few hours to a few days. Between 2006 and 2018, around 80% of sub-Saharan African firms suffered frequent electricity disruptions, typically six hours in length, imposing losses of around 8% of annual sales on average. Outages tend to be most frequent and prolonged in Nigeria. By contrast, firms in Organisation for Economic Co-operation and Development (OECD) countries experience interruptions of around one hour per month on average"* [IEA, 2019:135, citing World Bank, 2018].

The International Financial markets are the only realistic source for this magnitude of financial need – hence the importance of my dissertation's research topic.

## 5. Not a revisitation of the *Washington consensus*

It has been my experience during my academic journey, that despite learning of the importance surrounding identifying, understanding, and avoiding bias – many of my academic colleagues often apply their own biases when they review others work. I discovered this particularly during my various peer reviews, that my three papers went through for approval for publication. I/we were frequently being criticised for not writing the paper that the reviewer had thought was (or wanted to be) written, rather the one that I/we had written. To protect me from this problem, my co-author (and supervisor) Ben Sovacool, taught me the importance of good signposting and the removal of any ambiguity. To ensure clarity about my research positioning within the body of knowledge therefore, this section confirms the novelty of my research – at least, as assessed against the Washington consensus yardstick.

The reason I am particularly worried about a mispositioning of this nature, is that I have often found that when I start to explain my research interest to a development focused academic, there is an immediate enquiry about whether I am attempting to revisit the *Washington consensus*. This used to bemuse me, because I fathomed the only reason I was being questioned, was that I was advocating a private sector narrative to which they were ideologically hostile. I now realise that I too was biased, and perhaps there are more nuanced reasons behind their questions.

### *5.1 What is the Washington consensus?*

The term Washington consensus appears to be one of the most ambiguous and contentious terms, within the development academic field. It is highly emotive, yet clearly undefined. It also appears to be both descriptive and prescriptive, depending on who is describing it. John Williamson, the economist who first used the expression in 1989, has identified at least three distinct narratives of application [Williamson, 2004A & 2004B]:

- The first narrative encapsulates a descriptive list of ten policies that contribute to successful economic development, which John Williamson had identified and claimed were widely subscribed to by: The World Bank, International Monetary Fund (IMF) and the US Treasury Department (the Washington located, Bretton Woods Institutions), to be desirable in just about all the countries of Latin America in 1989. These surrounded **Fiscal Discipline; Reordering Public Expenditure Priorities; Tax Reform; Liberalizing Interest Rates; Competitive Exchange Rates; Trade Liberalisation; Liberalisation of Inward Foreign Direct Investment; Privatisation; Deregulation and Property Rights** [Ibid].

- The second narrative encapsulates a prescriptive list of economic policies, derived from a consensus of thought, within the Washington based Bretton Woods Institutions for developing countries in general. These included Williamson's original list of 10, and further additions primarily advanced/identified by Professor Dani Rodrik [2002]. These additions included: **Legal/Political Reform; Regulatory Institutions; Anti-corruption; Labour Market Flexibility; WTO Agreements; Financial Codes and Standards; Prudent Capital Account Opening; Non-intermediate Exchange-rate Regimes; Social Safety Nets and Poverty Reduction** [Williamson, 2004A & 2004B]**.**

- The third narrative is a positional one, designed to facilitate a new development policy prescription (or consensus). It does this by grouping flawed neo-liberal or free market orientated policies to suggest a developmental policy landscape that is failing, to champion a new enhanced prescription – A post-Washington consensus – to replace the flawed original one [Ibid].

What all three narratives have in common is that they involve a macro or top down approach to deliver a systemic solution for development, with what appears to be little bottom up input. This differs from my dissertation's positioning: which seeks to

understand a process that is problematic – private investment in African electricity infrastructure – by seeking to understand and improve aspects of its organisation (its governance) in order to improve how it works. My dissertation does of course overlap with these three narratives, but I am not championing a new development narrative as a replacement.

## 6. A generational opportunity needs embracing

When I first commenced my PhD, I did so with a different research question in mind, which was '*Why is the private sector reluctant to finance large-scale electricity network infrastructure in sub-Saharan Africa?'* I have a financial markets background, and due to this I was aware that there existed an unprecedented opportunity to reset a failing investment paradigm surrounding SSA infrastructure investment. Global interest-rate levels were, and still are, at historically low levels: denoting that there has never theoretically been a better time for Africa to attract private investment to build its urgently needed infrastructure, as the investment maths have never been more supportive.

All privately financed infrastructure investments require long dated time horizons, usually more than 20 years. This is to ensure its viability as an investment, in order to repay the investor's initial value and the expected investment return (see my conceptual framework in Chapter 2). This is because constructing infrastructure has very high up-front cost to build it, but it is then expected to have a long *useful life expectancy*, as infrastructure after it is built is expected to be usable for many decades. Traditionally, the excessive cost associated with the 'time value of money'[3], made the maths of privately financed infrastructure in SSA, unviable – particularly after adding a risk premium for the African region. Therefore, infrastructure in SSA has usually only been paid for by governments, or by investors that do not have normal investment returns as a priority: such as Development Finance, Institutions (DFIs) or mining companies, who can justify cross subsidising the cost of electricity for other strategic reasons.

Infrastructure as an asset class within the OECD has proved attractive to professional investment fund managers over the last decade. It has established a strong record of accomplishment that highlights its potential to enhance returns and mitigate risk as part

[3] **Time value of money**: the concept that **money** available now is **worth** more than the identical sum in the future, due to its potential earning capacity. This core principle of finance holds that provided money can earn interest, any amount of money is **worth** more the sooner it is received [Gallagher & Andrew, 2000].

of a broader portfolio [J.P. Morgan Asset Management, 2017]. The international financial markets: which consist of pension funds, insurance companies, sovereign-wealth funds, mutual funds (to name the major constituents) – also have more than 100 trillion $US in assets under management to invest [Arezki, R. et al, 2016; AfDB, 2018]. These represent investors that are desperately seeking higher investment returns, in contrast to those currently on offer, as just alluded too – due to the current global low interest-rate levels.

With historically low interest rates, infrastructure's solid investment reputation, the total value of investment resource available, and Africa's clear investment need for such infrastructure to be constructed – there is clearly a research priority to understand why there is such little enthusiasm by private investors, for financing SSA electricity infrastructure.

## 7. What is my significant contribution to knowledge?

I believe my thesis contributes to the body of knowledge in two ways. **Firstly**, I believe I am effectively redefining what is causing a very stubborn policy problem: why the private sector is reluctant to invest in sub-Saharan Africa electricity infrastructure. This includes in my discussion/conclusions chapter: identifying **eight key findings** which create investment inertia characteristics; and include a number of specific market breakdowns (see chapter 6, sec.3). In my policy discussion that follows (chapter 6, sec.4), I believe I add to this contribution, with some further interesting policy analysis of the findings.

**Secondly**, I believe this thesis has carried out invaluable empirical research in South Africa, surrounding what has gone wrong with the Medupi and Kusile power projects: whose development have bankrupted Eskom over a fifteen-year period. When something goes wrong that is very costly and unaffordable, it is important to understand both what went wrong and what is required to prevent it from happening again (chapter 5).

# Chapter 2:

# *Research Design*

The purpose of this chapter is to explain why I constructed my thesis in the way that I have; and consequentially illuminate why I chose the three individual paper's subjects and conceptual approaches, as presented in chapters 3, 4 and 5. I accomplish this by first outlining and explaining my working assumptions for my PhD research; I then clarify and explain my dissertation's research questions and hypothesis, before unpacking my use of the term governance (a subjective term), as it is my lens of analysis. Finally, I move onto my conceptual framework for my entire thesis, including a defence of the conceptual approach of each individual paper. This defence includes an explanation of how each paper builds on the proceeding one (in a complimentary manner), and how together they contribute to the body of knowledge surrounding my *greater* research problem: why is the private sector reluctant to finance large-scale electricity network infrastructure, in sub-Saharan Africa?

## 1. Working Assumptions

Before I commenced writing this thesis, I recognised during preliminary research that there has existed since the 1990s (and the Chairmanship of the World Bank by James Wolfensohn), a dominant international development policy narrative for resolving SSA electricity access [Collier, 2014; Eberhard, 2015]. This narrative advocates that the solution to SSA electricity poverty should predominantly require the private sector to finance the construction of much-needed new electricity infrastructure.

It is observable that the private sector has been unenthusiastic in engaging with this policy narrative: evidenced by Africa only accounting for just 4% of global power supply investment, despite being home to 17% of the world's population [IEA, 2019]. This percentage would be even lower in the sub-Saharan region (excluding the RSA, a statistical outlier) as North Africa (the balance) has almost universal access to electricity [Ibid] and therefore must be attracting a larger percentage of investment than SSA. This lack of enthusiasm to invest in the sub-Saharan region is despite this financing policy

narrative having been in place for more than 20 years. India, by contrast, between 2000 and 2016 reduced the number of its people without electricity from 57% to 18% of their population [IEA, 2017].

Using the knowledge of this policy narrative for my thesis' orientation, my working assumption for my research is that the central cause for electricity poverty in SSA (described in the introduction of this thesis) is due to an insufficient amount of electricity infrastructure required to deliver reliable and affordable electricity services to the continent's ever-growing population. Further, this is due to an inability to finance the construction of such necessary electricity infrastructure, due to the existence of several excessive and unmanageable risks, which in turn have created several types of market-breakdowns in the region (Chapter 6, sec.3).

To support this positioning, it is observable that much of the sub-Saharan region's economies are still semi-industrialised (or agrarian focused), with in excess of 60% of their populations located in rural areas where the vast majority of people rely on subsistence agriculture for their livelihoods [IEA, 2019]. The lack of economic development then leaves such populations compromised in their ability to afford the cost of electricity service supply, when using dominant classical (and linear) economic analysis. Further, such a lack of industrial development has left nearly all the region's governments unable to finance such construction from their own internal revenues. As well as preventing these governments from borrowing from private sector sources, as their country's financial rating are below investment grade (as defined by the global credit rating agencies[4]). Additionally, each sub-investable country's electricity utility have even lower investment ratings than their governments [Kojima and Trimble, 2016]. I discuss and expand further this 'financing reality' and type of market-breakdowns in both my first two published papers, which form chapters 3 & 4 of this thesis.

The central role of credit rating agencies (CRA), is to provide risk assessments surrounding the ability/willingness of an entity, to stand behind a contractual requirement to pay (are they credit worthy). These rated entities are usually financial instruments, companies, or governments. The agencies apply a specialist capability involving a degree of confidential methods that they have evolved over 100 years[5], to evaluate whether an

[4] The three-principle dominant global credit rating agencies are Standard & Poor's Investor Services, Moody's Investor Services, and Fitch Ratings.
[5] Standard and Poor's trace their history back to 1860
https://www.standardandpoors.com/en_US/web/guest/home

entity is reliable enough to pay their financial obligations [Deb et al, 2011]. Such institutions supply a form of risk management function, which surrounds knowledge asymmetries. They make themselves informed about credit worthiness of the companies that they rate, and then sell that knowledge to their clients – who do not have the resources available, to collect such a valuable evaluation for themselves. Part of what makes that knowledge valuable, is the reputation of the agency to provide accurate information: they therefore take the management of their reputations seriously [Becker & Milbourn, 2011].

The CRAs are private companies, whose business model also relies on charging the entities that they credit rate a fee. Their ongoing protection of their reputation means that they need to properly resource the process surrounding whatever entities they do rate – for fear of damaging their greater reputation. Widely rating African based entities, is not judged as commercially viable by these agencies, and so they do not offer such a service. Furthermore, investors do not like to invest where there is currently no CRA rating. This represents a type of market-breakdown.

## 2. My hypothesis and research questions

My dissertation's methodology uses a Hypothetico-deductive approach.

**My Hypothesis**: The private sector is reluctant to finance the development of new electricity infrastructure in SSA because there exist excessive and unmanageable risks – which in turn have created several types of market-breakdowns (see Chapter 6, sec.3). These risks principally arise out of issues of governance and capabilities.

**My Primary research question**: 'What aspects of governance deter private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa?'

I am hypothesising that the ability to finance the construction of new electricity infrastructure capacity in SSA privately, is a dependent variable, which is constrained by excessive risks that arises from two types of enabling variables. These two enabling variables are associated with issues of governance [Hufty, 2011; Booth, 2012; Florini & Sovacool, 2009] and an adequate level of capabilities: both individual [Cook, 2011; IEA, 2019; Sen, 1999] and institutional [Abramovitz, 1986; Bell & Pavitt, 1993]. Due to the considerable scope that an analysis of both sets of variables would entail (and on the advice of my supervisors), this thesis has just focused on identifying and understanding

the variables derived from the issues of governance, that deter private investment. I have also identified some of the variables derived from capability issues, as the two factors overlap, but I have not specifically applied a capability lens to my research in the way I have applied a governance one.

My motivation for my initial analysis that led to my hypothesis, arose out a greater research problem, which presented an original research question: 'Why is the private sector reluctant to finance large-scale electricity network infrastructure in sub-Saharan Africa?' – Which I have already contextualised. As my research continued to evolve whilst unpacking this problem, so has my appreciation of my original research questions lack of precision. Consequentially, I re-evaluated what I needed to understand, and instead sought to appreciate how governance creates risks that impact investment.

As I am just focussing on issues to do with governance in my PhD, I am now interested in answering two different research questions. The first replaced my original thesis research question, as well as becoming the research question of my second published paper: 'What aspects of governance deter private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa?' The second arose as I started to unpack the development problems surrounding large scale network infrastructure (megaprojects), which then became the research question behind my third published paper: 'What aspects of project governance are important, to prevent time delays and cost overruns, when building large scale electricity infrastructure in South Africa?'

# 3. Governance: my lens of analysis

Governance is a subjective term, with great variance amongst academics for what it encapsulates. In this thesis, it describes an organisational process that has two dimensions: firstly, what it involves; and secondly, who/what it embraces. Broadly, it involves any multitudinous processes or institutions in place: by which people set and enable any rules needed, to attain desired outcomes [Florini & Sovacool 2009]. While frequently applied to the domain of governments, many other contexts are observable for using an organisational process of governance: including civil society organisations, projects, corporations, and institutions of finance.

Traditionally, when the literature utilises the term *governance* to explain why the private sector is unenthusiastic for investing in the region's electricity infrastructure, it is

applied with a narrow interpretation that centres on negative behaviours such as corruption [Booth, 2012]. Such a narrow application of *governance* I argue in this thesis, oversimplifies the extent of the inclusion for what the term should capture, as it ignores the polycentric or systemic level complexity that cuts across the actors, networks, and knowledge structures, needed to address investment.

In this dissertation therefore, I argue that *governance* as a term when being applied to electricity service delivery in SSA must have a wide scope, that encompasses all organisational processes between all applicable stakeholders within the electricity service delivery system. This would include factors such as institutional capacity, political stability, bureaucratic flexibility and system and sub-system organisation. I develop these ideas further in chapter four; and give them further dimensions, in chapter five.

# 4. Conceptual framework

During the analysis of the results of my systematic review, summarised in my first published paper (chapter 3), I theorised that the concepts surrounding private investment and how it is influenced by risk, are not well understood by many development academics. This is probably because 'international-development' as an academic discipline is usually viewed through a public sector lens rather than a private sector one – and private investment theory is only relevant to a private sector narrative. In this section, I therefore clarify what factors are important surrounding private investment, within my conceptual approach.

## *4.1 What does 'private investment' mean in this thesis*

In most of sub-Saharan Africa (excluding South Africa), each country's financial institutions are unable to privately finance any significant capacity increases in network electricity infrastructure, as there are few significant banking, corporate, non-government institutional, or 'private office' investors with the capabilities to carry out such types of investment [IFC, 2016; Gregory & Sovacool, 2019; Sovacool and Cooper, 2013]. Therefore, in the context of this thesis, private sector investment will refer to internationally sourced (out of region) private investment.

### *4.2 Why is private investment influenced by risk?*

Applying Occam's razor: an investment can be defined "as the act of incurring an *immediate cost* (the value of the investment) in the expectation of receiving future *rewards* (the investment return)" [Dixit & Pindyck; 1994:3]. By using this definition, it can be observed that there are two related, but separate elements involved in an investment decision; and that investors require certainty of outcomes from the second element, in response to the first, for an investment to proceed. Yet this gap in time between these two parts of the investment process, also introduces the possibility of uncertainty to an investment decision, as the *reward* expectations may not have been realised by the time the second part of the process is meant to conclude. Adding to this, a decision to proceed with an investment is a relative decision, as any individual investment opportunity does not exist in isolation. There are otherwise many alternative investment opportunities that are pursuable – or applying economic theory: an *opportunity cost* occurs after the confirmation of an investment decision, as the committed resource is no longer deployable elsewhere. [Bessis, 2015; Dixit & Pindyck, 1994; de Jager and Rathmann, 2008; Garcia, 2017; Pindyck, 1986].

Additionally, an investment in the development of new electricity infrastructure in SSA will be illiquid – meaning that the investment cannot be easily: removed, sold, or exchanged for cash without a potential significant loss of value [Longstaff, 2001; Pindyck, 1986]. In any sort of electricity infrastructure development in SSA, the investment's value will be tied to the location that the asset has been constructed within (the asset cannot simply just be removed and taken away intact) [Levy, 2014]. The only way therefore for the investment to realise its value as an investment, is for it perform as it was intended when the investment was planned. I understand from the economics academic literature, that this issue is describable as a *'Hold-up' Problem from Game theory* [Ellingsen & Johannesson, 2004]. Finally, infrastructure investments of this type will be long dated, usually more than 20 years (see chapter 1, sec.6); and if their tariffs are correctly set and regulated, such infrastructure will represent a 'normal' margin business[6], without excessive profitability [Blimpo & Cosgrove-Davies, 2019; Garcia, 2017; IEA, 2019; UNCTAD, 2017].

[6] **Normal Margin** is determined by a 'benchmark' interest rate such as LIBOR, plus a weighted average cost of capital (WACC). WACC is a calculation of a firm's cost of capital, where each category of capital is weighted to represent its relative exposure to risk compared to its alternative uses, and its absolute risk profile [Garcia, 2017].

So, after taking all these factors into account – it is deducible that a private investor's willingness to proceed is determined by the perceived level of risk that surrounds the ongoing value of their '*immediate cost'* of entering that investment; and the likelihood of attaining the expected '*future rewards'* [Bessis, 2015; Dixit & Pindyck, 1994, Garcia, 2017; Pindyck, 1986]. Moreover, a negative causation is clearly observable: an increase in risk decreases the desire to invest.

## *4.3 Why risk is particularly problematic for investment in SSA*

To protect an investment's '*immediate cost* (assuming there is enough comfort in the assumptions underlying an investment proposal, to make it appeal enough to proceed), an experienced investor usually seeks a form of *surety*[7] through one of following three risk mitigation strategies, to manage their value exposure [Bessis, 2015, Garcia, 2017]:

1. Asset backed 'surety' – the entire value of the *'immediate cost'* of the investment is secured against the value of another, separate and unrelated asset. The value of the risk is therefore directly protected from being lost.

2. Balance sheet 'surety' – an entity (in my thesis' context, usually a company or government) has the financial size and strength to be accepted to guarantee directly the value of the *'immediate cost'* of an investment; and/or the investment's expected financial outcomes: the '*future rewards'*, such as interest payments or dividends. The value of the risk is therefore transferred to a third party, which guarantees the value against being lost.

3. Project financing – A project's cash flows ('*future rewards'*) are pre-determined and discounted back to a value today, to create an NPV (net present value); and then protected or guaranteed in some way. Provided the NPV is significantly above the actual cost of construction and delivery, with a suitable risk-weighted return – The project is deemed as bankable[8], and the required financing can be secured and advanced against this projected value [Yescombe, 2002]. In this way, the NPV value acts as the surety, and the value of the initial investment is protected.

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[7] **Surety**: in this context, is where something valuable that is not money, is offered by an investment recipient (the insider) to an investor (the outsider), to help assure the value of the initial investment is secure and returnable

[8] **Bankable**: A project or proposal that has sufficient substance, cash-flow, and likely future success to be acceptable to future institutional lenders

All three approaches exist to either offset the risk of losing the value of the *immediate cost* of an investment and/or guarantee the *future rewards*. In SSA however, the first two approaches are difficult to apply. There are few suitable assets available to act as surety; and most of the relevant government owned electricity utilities are not sufficiently credit worthy to be an acceptable 'counterparty' for such surety, to the investor [Gentzoglanis, 2013; Kojima and Trimble, 2016] – both are a form of market-breakdown. Further, the relevant governments are either unwilling or unable to offer surety [Amars 2017; Eberhard & Shkaratan, 2012]. The only realistic lending approach that is available in the SSA context is *Project Financing*. However, the reliability and security surrounding construction costs and ownership of the assets; and the predictability of the required cash flows, are hard to guarantee due to the existence of significant risks that can undermine the certainty of both these values – and this is one point of focus for my PhD.

### *4.4 Network infrastructure: a doubling of the problem*

The predominant type of structure that is utilised in SSA for delivering electricity services, is a top down network 'hub & spoke' system [Blimpo & Cosgrove-Davies, 2019; IEA, 2019; UNCTAD, 2017]: organised as a series of large-scale electricity generating assets, with supporting transmission and distribution networks. This is also the standard and successful model used by all OECD countries for delivering electricity services.

This *standard model* is however proving unfit for purpose in a SSA context. It is a 'path dependent' model [David, 1994; Nelson & Winter, 1982], which in SSA is inflexible towards accepting new technologies and organisational improvements; and therefore, is proving both expensive and problematic to extend and operate. In SSA, it manifests as a government-controlled monopoly utility that is both under resourced and ineffectively managed [Ibid]. Also, unfortunately for investors, as a structure of organisation its efficiency is co-dependent on its constituent parts – meaning any deficiencies in one part of system, will negatively influence the entire system.

> *"Under-investment in existing transmission and distribution assets and the inability to meet peak load due to installed capacity deficit result in frequent service disruptions (unscheduled outages or regular load shedding), ranging from a few hours to a few days. Between 2006 and 2018, around 80% of sub-Saharan African firms suffered frequent electricity disruptions, typically six hours in length, imposing losses of around 8% of annual sales on average"* [IEA, 2019:135; citing World Bank, 2018].

As an investment proposition for a private investor, SSA electricity infrastructure represents a double challenge as an investment. Must not only the direct asset that is being invested in, function as planned for to permit a successful investment – but so must the larger system that it will operate within. A very challenging proposition in this context.

### *4.5 What is relevant: my risk filter*

When applying the above dynamics surrounding an investment as a backdrop, I can reason that a potential private investor will always apply the following three questions, to determine whether to proceed with an investment:

(i) Is it realistic to expect a reimbursement of the value of the investment (the initial cost) in the future?

(ii) Is it realistic to expect to receive the anticipated returns (the rewards) when they are expected?

(iii) How does this investment opportunity, compare with every other investment opportunity that is available?

I use these three questions continually during my research, to determine what makes a project bankable: they have acted as a filter, verifying the veracity of my research analysis.

### *4.6 Public, private and hybrid ownership models of electricity systems*

It can be easily observed throughout the international system of sovereign states that we all inhabit, that there exist three accepted models of ownership and control of electricity service delivery. **Firstly**, there is a full public ownership model, where the state owns and manages this type of infrastructure on behalf of its citizens. At the centre of this model is the ethos that electricity is a 'merit good': a commodity which is considered by society as fulfilling a social need and so its allocation is not just decided upon by price [Dilnot & Helm; 1987].

**Secondly**, there is a private sector model, where the infrastructure is fully owned and managed by the private sector. In this model, the social aspect for allocation is removed and instead the provision of electricity is determined principally by price [Ibid]. In this model, government has determined that they do not required ownership of the system, to have influence over how it operates, as they still can act as regulator. In the judgement of

its private owners, the primary function of the business is to maximise profits rather than supply a social good [Ibid].

The **third** model type is a hybrid of the two. Usually this entails total government/state ownership of at least the transmission/distribution part of electricity supply; the generation of electricity is usually opened to competition from non-state actors. The ambition of this model is to appropriate any 'efficiency benefits' of private operation, and to make the delivery system less hierarchical and more responsive to the needs of its users [Hood, 1991], To enable this, the utility is corporatised and its management are expected to adopt private sector 'best practises' to gain operational efficiencies and make the utility responsive and focused towards its end users [Pollitt and Bouckaert; 2004].

The hybrid model exists in both the RSA and Kenya and are discussed in this thesis' Chapter five and Chapter three, respectively. The dominant model in much of SSA however, is a public sector ownership model, where the entire electricity delivery system is controlled by their respective governments. The functioning of this type of model is then often captured by the needs of the ruling party, to serve its own neo-patrimonial interests first (see Chapter 4, sec.5). As can be observed in my fifth Chapter, the hybrid model can also be vulnerable to political capture too (Chapter 5, sec.4). If the ANC (African National Congress) had not been so dominant over the South African Political landscape since 1994, it is possible the situation researched in Chapter five, may have been very different.

## *4.7 Public verses private and the impact of spillover externalities*

A financially well-resourced government as the owner and manager of electricity infrastructure, can operate its infrastructure in a fundamentally different way to the private sector. Governments are able to capture a much higher level of reward from the existence of the infrastructure, as the wider country (and therefore the government) benefits from the 'positive externality spillover benefits' that accompany such infrastructure [Pigou, 1932], and they have an ability to recoup the value through their tax system (which they control). They can also dilute the consequences of costly mistakes, by absorbing and mutualising them into the national structure of the state. This reality, from the perspective of policy, can allow them to therefore operate their electricity infrastructure assets at a commercial loss.

The private sector enjoys no such luxury. When the private sector builds and operates infrastructure, it is not able to capture any of this spillover benefit, due to the linear nature of the rewards of such an investment (see chapter 6, sec.4.5). Instead, all it can capture is the proposed asset's revenues (electricity sold and paid for, in this case) whilst being fully exposed to the financial consequences of any mistakes in planning and operation. The private sector can only protect itself by the management and reduction of risk surrounding their infrastructure investment [Dixit and Pindyck, 1994]. A belief in the existence of Hirschman's *hiding hand* [Hirschman, 1967] – where the costs or challenges of building an asset are under-represented, and the benefits and revenues that can be derived form that asset are over represented – is also a substantial negative for private investors, particularly if the scale of investment asset is substantial [Flyvbjerg, 2017a]. There will also be a greater knowledge asymmetry against the investor, in a development context – this is a form of hold-up problem, discussed in chapter 6 in my **key findings V**.

The public-sector perspective, which perceives electricity delivery as a merit good, is still the default narrative within many SSA governments and much of the international development policy communities and literature (see my systematic review, chapter 3). This narrative still assumes that governments will drive a solution to SSA electricity poverty. However, the governments of SSA do not have well-resourced balance sheets [Blimpo & Cosgrove-Davies, 2019; CEPA, 2015; Kojima and Trimble, 2016] and currently require external financial support to construct any meaningful amounts of infrastructure. It is likely that the acceptance of this reality, has dictated the continuing dominance of the multilateral development policy for advancing a private investment led solution.

## 5. Defending the conceptual approach of each paper

In effect, I believe the success of my PhD will be determined by two outcomes. Firstly, my ability to identify any factors that can remove value from the *immediate cost* of an investment in electricity infrastructure in SSA and ascertain their probability of occurring (the investment risks). Additionally, I need to establish how to improve the certainties surrounding the appropriation of the *future rewards* of such investments, which were anticipated when the investment was planned (*sec.4.2, Chapter 2*). This is the essence of

making a project bankable, discussed above in sec.4.5. Each of my published papers achieves this, in some manner.

### *5.1 First paper - "The financial risks and barriers to electricity infrastructure in Kenya, Tanzania, and Mozambique: A critical and systematic review of the academic literature".*

(I co-authored this paper with my principal supervisor Professor Benjamin Sovacool; Energy Policy accepted it for publication in October 2018 – see earlier Declaration of previously published works, at the start of this thesis).

The research objective of our (co-authored) first paper was to deliver two requisites: firstly, to understand how the recent academic development literature (1st January 2012 – 30th June 2017) explains the barriers (or risks) that obstruct the private financing surrounding the development of SSA electricity infrastructure. Secondly, we classify these risks as part of a broader landscape. This landscape also includes any likely risks from a greater indirect, but still relevant, interdisciplinary literature, which could also negatively influence a private financier's willingness to invest in this type of infrastructure – based on my thesis' conceptual framework.

This paper's data is only for a five-and-a-half-year period, to ensure it was a manageable sample – whilst still being deemed a sufficient length of time, to deliver a complete enough picture for a meaningful and useful analysis. We were in effect, validating the novelty of my thesis' hypothesis and my theoretical approach, to confirm that I will be contributing to the body of knowledge.

To further ensure that my research sample was manageable, we chose only three African countries that already had a notable body of academic literature concerning them: Kenya, Mozambique, and Tanzania. Whilst we recognised that using just three countries to represent the entirety of the SSA region is problematic – as is to extrapolate any country factors to represent the entire sub-Sahara African region, when carrying out research – we have done so, as the research is essentially 'top down' and focussing on the investor needs, not the recipient countries. Our research is actually seeking to understand the behaviours of the international investment community's approach to a type of investment, which can be standardised as they have a commonality of purpose in the way they approach investment: these investors are all seeking an investment return, from an initial commitment of investment value.

### *5.2 Second paper* - "*Rethinking the governance of energy poverty in sub-Saharan Africa: Reviewing three academic perspectives on electricity infrastructure investment*".

(I co-authored this paper with my principal supervisor Professor Benjamin Sovacool; Renewable & Sustainable Energy Reviews accepted it for publication in April 2019 – see earlier Declaration of previously published works, at the start of this thesis).

The second paper is theoretical and utilises three separate perspectives to deliver a holistic and inclusive governance picture, to answer the following research question: 'What aspects of governance deter private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa?' These perspectives comprise: 1) Financial Investment Governance**,** the private sector investor's perspective, which focuses on the rules and institutions (or lack of) that directly influence the financial investment environment in SSA. 2) Political Governance, the political economy perspective, which relate to the negative, indirect investment consequences resulting from the way that SSA governments govern; and 3) Technological Governance, a 'systems' perspective, which encompasses how the standard structure and organisation of the wider electricity delivery system in each country in SSA, negatively impacts such investment.

We believed the approach has novelty and academic value, due to the subjectivity and narrowness with which governance is usually applied to investment. We argue that traditionally researchers have not unpacked the term enough, to capture all the relevant variables that can influence such investments. The paper's discussion section delivers a novel list of fifteen structural governance factors (some of which are unique to the SSA region) that require appreciation by 'policy actors' – which we believe particularly is an addition to the body of knowledge.

### *5.3 Third paper* - *"Governance, scale, and scope: reviewing six South African electricity generation infrastructure megaprojects".*

(I sole authored this paper, and it is currently undergoing peer review in Utilities Policy – see earlier Declaration of previously published works, at the start of this thesis).

My third paper adds to the dynamics of governance, by focussing on the impact of governance surrounding large-scale electricity infrastructure development (megaprojects), by empirically analysing six case studies located in South Africa. The

paper's fieldwork was determined by the following research question: 'What aspects of project governance are important, to prevent time delays and cost overruns, when building large scale electricity infrastructure in South Africa?' This research question is relevant to the thesis' primary interrogation theme, as expectance to adhere to schedules and budgets are of central importance to investors. The completion of a project on time and budget is a primary requirement for the successful financing of infrastructure.

Whilst recognising that South Africa (RSA) is an atypical country in the region, RSA only case studies are used, as it is the only country that can offer any megaproject variance, within a single country in SSA – as this paper is a study of project, not national governance. During the analysis of the fieldwork's data, the importance of scale and scope to the primary interrogation theme was also observable and explainable. The impact of scale and scope now forms a part of the conclusion, for the entire thesis.

## *5.4 The common thread*

Each paper is intended to add a new layer of understanding, surrounding the causal organisational relationships between governance, investment, and electricity infrastructure development in SSA. I anticipate that such a holistic understanding can then permit policy makers to improve the SSA infrastructure investment landscape.

In my discussion and conclusions in Chapter 6, I lead with a defence of the policy of encouraging private finance to resolve SSA electricity poverty. I then highlight my key findings of my research surrounding current policy approaches, identified throughout my three papers. I then move on to discuss the problematic nature of my research landscape, including the examination of some new policy-tools to neutralise the different market failures that I have identified.

My aspiration for this thesis is that it might finally deliver some meaningful progress, for resolving perhaps one of the most stubborn policy problems in international development – how to comprehensively deliver universal electrification to sub-Saharan Africa.

# Chapter 3:

# *The financial risks and barriers to electricity infrastructure in Kenya, Tanzania, and Mozambique: A critical and systematic review of the academic literature*

(**Energy Policy 125** (2019); pages 145-153 – co-authored with Professor Benjamin Sovacool)

## Abstract

The recent academic literature contains several hypotheses or reasons to explain why electricity infrastructure has not been widely developed in sub-Saharan Africa (SSA) in the 21st century. In this paper, we argue that this literature is misdirected, or at least incomplete, in how it appreciates the impact of risk as an input behind this conundrum. We hypothesise that this lack of infrastructure development in the region, reflects a dearth of investment due to the existence of excessive negative uncertainties or risks – as investment is a function of uncertainty and reward. However, the recent academic development literature appears to not appreciate this as an explanation. To make this argument, we chose a manageable sample of three African countries, which already had a notable body of academic literature concerning them: Kenya, Mozambique, and Tanzania. Focusing on these countries, we then undertook a systematic review of 815 'peer reviewed' papers published on the academic libraries of Scopus and/or the Web of Science on the topic of electricity, infrastructure, and risk over a five-year period to see how this literature evaluated the problem. Drawing from the most relevant 101 studies within that sample, we critically examine the methodological, conceptual, and empirical aspects of this literature.

# 1. Introduction

It has been 139 years since Thomas Edison patented his lightbulb in 1879; 46 years since the structure of Overseas Development Assistance was formalised in 1972; and 18 years since the United Nations Millennium Development Goals declaration in 2000. More recently the Sustainable Energy for All initiative was launched, and the Sustainable Development Goal 7, specifically dealing with energy access, was prioritised [Ockwell and Byrne, 2017; International Energy Agency, 2017; Gollwitzer et al., 2018]. Yet despite these supposedly positive 'milestones' for electricity accessibility, eastern Africa remains one of the world's most electricity deficient regions.

According to the most recent data from the International Energy Agency [2018], 75 million people living in Kenya, Tanzania, and Mozambique did not have any access to electricity. From an economic growth perspective, access to reliable and affordable electricity in Africa is a major developmental obstacle [AfDB, 2018; Briceño-Garmendia et al., 2008; Halff et al, 2014; Moyo, 2013].

In this study, we argue that the academic community needs a more comprehensive structure for identifying risk on this topic. We operationalise risk as including the factors that are material and cannot be predicted, that negatively impact investment in electricity infrastructure, which we call risks or 'negative uncertainties'. To make this argument, we undertook a systematic review of 815 academic studies published in two academic databases on the topic of electricity, infrastructure and risk in Kenya, Mozambique, Tanzania and SSA over a five year period of 2012–2017. Drawing from the most relevant 101 studies within the sample, we investigate the methodological, conceptual, and empirical aspects of this literature.

We find that there is a need to deliver a more useful conceptual framework concerning risk, as well as for creating 'bankable' electricity infrastructure development projects. We argue that new classifications of risk are needed to better understand the financing of electricity infrastructure development, than those that exist within the literature. This framework can then be used to influence policy, to support the development of such new infrastructure by the private sector, in the countries of Kenya, Tanzania, and Mozambique (and perhaps beyond).

In proceeding on this path, the primary contribution of this paper is to reformulate the relevance of risk within the academic research community. Admittedly, electricity

demand (kWh) is a function of varying contextual factors such as availability of resources, electrical appliance ownership, duration of usage, and the viability of tariffs—all of these impact the innovation ecosystem affecting energy services [Kowalska-Pyzalska, 2018]. Moreover, there is often a direct or at least meaningful relationship between household economic poverty and energy burdens and energy poverty: the poorer households are, the higher their energy burden, yet poorer households tend to access cheaper alternative energy options, when electricity tariffs are high [Sovacool, 2012; Monyei et al., 2018a, 2018b; Bohlmann and Inglesi-Lotz, 2018].

In an attempt to address energy poverty, the IEA initially estimated that US$389 billion needed to be spent on the development of new sub-Sahara African (SSA) electricity infrastructure, to achieve the UN's Sustainable Development Goal of universal access to electricity for all in the region, by 2030 [Myers, 2013-citing the IEA]. More recently, the IEA estimated [2017: 5] that *"providing electricity for all by 2030 would require annual investment of $52 billion per year, more than twice the level mobilised under current and planned policies. Of the additional investment, 95% needs to be directed to sub-Saharan Africa."*

Thus, a significant portion of electricity investment will need to be directed at Kenya, Tanzania, and Mozambique. The only realistic source for the level of financing, that the IEA suggests is required by 2030, is from international financial markets. These international markets consists of pension funds, insurance companies, sovereign wealth funds, and mutual funds (naming the major constituents). Combined, these institutional investors have more than $US100 trillion in assets under management [Arezki et al., 2016; AfDB, 2018]. Harnessing private sector finance therefore offers an incredibly promising but underutilized tool for expanding access to electricity and reducing the extent and severity of energy poverty.

## 2. Research design: conceptualising risk and undertaking reviews

This paper hypothesises that electricity poverty in Kenya, Tanzania, and Mozambique is caused by the inability to finance the construction of new electricity infrastructure in the region; and this inability is caused by excessive 'risks', that surround the development

process of electricity infrastructure. These risks then cause such developments as an investment proposition, to be unattractive to the private sector.

## *2.1 Interdisciplinary conceptions of risk*

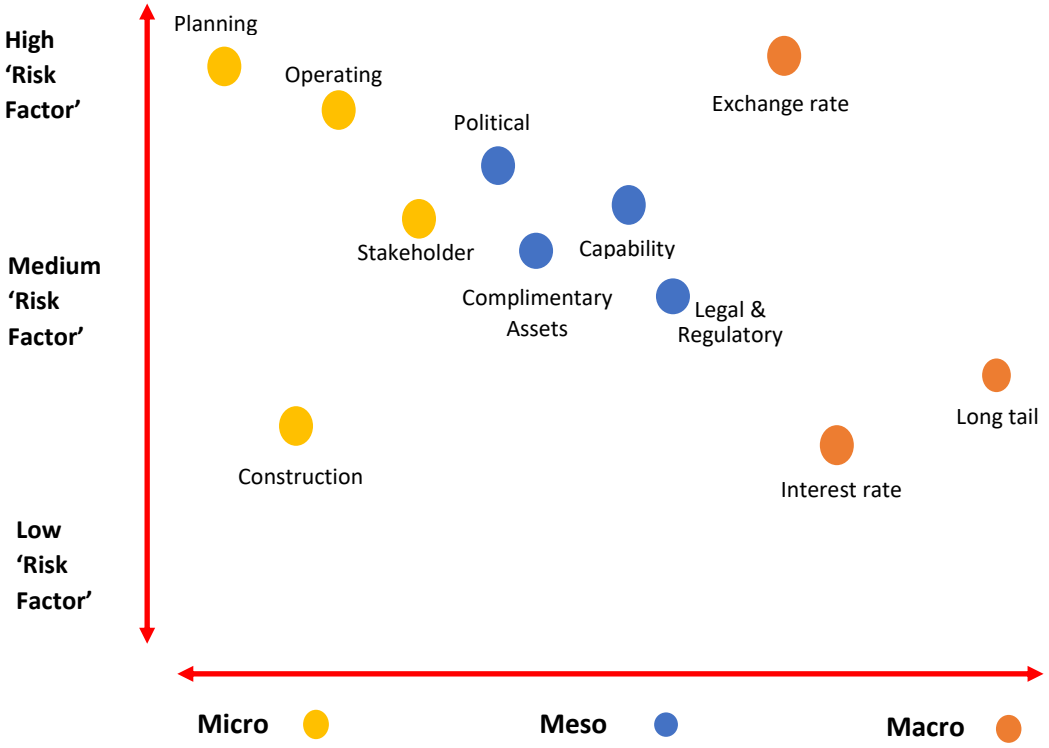
To make this case, we firstly carried out an interdisciplinary review of the literature on risk utilising four separate academic disciplines: investment finance, project management studies, innovation studies, and international development studies. The investment finance literature demonstrates how negative uncertainty or risk in our context influences electricity investment in eastern Africa. It utilises the highly cited theories of Dixit and Pindyck advocated in "Investment under Uncertainty" [1994], as they are the most applicable to the eastern Africa context. The project management literature delivers a framework for identifying and classifying risks, as this forms a major part of that disciplines theory. The innovation literature offers a contribution to theories on the 'diffusion of technology' in developing countries [Rogers, 2003; Abramovitz, 1986], as electricity infrastructure development is essentially a diffusion of technology through projects. The development studies literature emphasizes linkages between energy infrastructure and dimensions such as aid dependence, governance, corruption, and democracy.

From the project management literature, we can see that uncertainty does not necessarily constitute a barrier for such investment, as uncertainty can be a positive when it represents an opportunity [Chapman and Ward, 2011; Hillson, 2004]. Therefore, the uncertainty that needs to be identified, are the negative uncertainties 'that matter' [Hillson, 2004], which in this paper we will now call 'risk'. Additionally, there are three further factors that need to be grasped from the literature about how risk can undermine a project's 'bankability'. Firstly, are the illiquid properties of an electricity infrastructure investment, the investment's value will be tied to the location that the development has been constructed within (the asset cannot simply just be removed and taken away intact) [Dixit and Pindyck, 1994; Levy, 2014]. Secondly, no risks occur in isolation, all risks are interrelated and affect each other; and thirdly, some risks are more significant in their level of impact to a project's deliverables than others.

The first way to measure a risk's influence, is to evaluate whether it will lead to an absolute or proportional change in outcome; and if it is proportional, to what degree? An absolute change, in this context, is a change that will have binary characteristics – it will

alter the outcome completely or not at all. A 'proportional' change, in this context, is an incremental weakening of the expected outcome – but there will still be an outcome. Absolute risks are considered the most dangerous, but only if they are believed likely to happen [Hillson, 2004].

**Figure. 3.** Micro, meso, and macro conceptions of infrastructure risk.
(Data derived by the author)




**Note**: Micro factors include those at the project or infrastructure level; Meso factors national aspects such as regulations or assets; Macro factors global dynamics such as exchange or interest rates.

*The figure is descriptive only. It has been derived by the authors from the simple risk analysis found throughout sec.4.3 – at the end of each sub-section. These are not fixed measurements and require reappraisal if the scale of a project dramatically increases, becoming a megaproject (see Ch.5).*

The second way to measure the influence of risk is in its probability of happening. Some risks are never likely to happen, and therefore can be ignored – for example, a meteorite might hit the asset and destroy it (possible, but very unlikely). Others must be empirically predicted, utilising a combination of relevant historical precedents of possibilities and the ability to control or manage human behaviours and the applicable environment. Both these impacts are subjective and are matters of judgement, which means they can be influenced as much by perception as reality. The project management literature usually applies a sliding scale to both these factors [Hillson, 2004]. A high

impacting risk that is likely to happen, will always make an investment proposal unattractive and causing it to be rejected.

To help classify the relevant risks, two approaches are utilised here. Firstly, a bottom up approach, which separates risk into three separate fields: micro, or project specific derived risk; meso, or country specific risk; and macro, or systematic risk (see Figure 3). As the figure indicates, these risks occur not only across scales, making them polycentric. They also occur to different degrees, with some (construction costs or interest rates) reflecting low risk to project cancellation, whereas others (planning delays, poor exchange rates) reflect high degrees of risk that can scuttle projects, and still others fall between at a moderate or medium degree of risk.

Secondly, a linear approach can be applied to the micro risks, as these are all project specific. Standard project management theory, such as that used by the Project Management Institute, utilises a linear process of distinct management stages in a project's development. Extrapolating from this, we can separate three phases that can be impacted by risk. These are the planning, the construction, and the operation phases. A comprehensive planning stage will identify the construction and operational risks, as well as instigate remedies to manage them: these aspects have been split, for transparency. Lastly, there is a fourth important class of risk associated with the linear approach, but not specific to a single phase: this is stakeholder risk [Hillson, 2004].

**Figure. 4** – A linear illustration of project risk (Author's descriptive interpretation)


## *2.2 Systematic literature review*

To understand how the current peer-reviewed literature understands the issue of risk, the methodological tool of a critical systematic review was employed. A defined period was applied to the search, January 1, 2012 until June 30, 2017. Four geographic entities were interrogated: Kenya, Tanzania, Mozambique, and sub-Saharan Africa. Six search strings were utilised and examined in Scopus using the "Title, Abstract, and Keywords" and in the Web of Science applied to "Title and Topic":

1. Electricity and Finance.
2. Electricity and Risk.
3. Electricity and Challenges.

4. Infrastructure and Finance.
5. Infrastructure and Risk.
6. Infrastructure and Challenges.

This search originally delivered 815 studies, but these were reduced to 116 after filtering the title and abstract for relevance. After reading and reviewing the 116 papers, a further fifteen were also excluded on the grounds of relevance. The 101 remaining papers were then analysed and classified according to a coding schema.

The first two attributes coded, were about the demographics of the author and the research designs undertaken:

1. Where were authors located geographically?
2. What research methods were employed in the paper?

The third through eighth attributes concerned the analytical frames and qualitative themes and topics examined, namely:

3. Was access to financing, understood to be the principal cause of electricity poverty?
4. Was uncertainty discussed with reference to financing? If yes, what was its definition?
5. Was risk defined with reference to financing? – If yes, what was its definition?
6. Was the subject of 'bankability', discussed?
7. Were policy mechanisms to mitigate risk, such as Power Purchase Agreements or Feed-in Tariffs, discussed?
8. Were barriers to electricity infrastructure development, discussed? If yes, what form did they take?

The idea behind coding these eight categories, was that it would enable a deeper and systematic reflection of the geographies, research methods, and themes being applied in our systematic sample of the academic literature.

# 3. Results: Authors, methods, and themes in energy poverty scholarship

This section of the study summarizes our results of the systematic review, under the three broad headings of author demographics; research methods and designs; and themes and topics.

## *3.1 Author demographics*

Disappointingly, our systematic review uncovered that researchers located within African countries do not do the bulk of research carried out on eastern Africa. As **Figure 5** indicates, authors at institutions in Europe and North America accounted for a sobering 59% of the sample, with Africa (as a whole) only at 27%. This finding is potentially troubling given it suggests much work is perhaps desk based and/or done at institutions with stakes in the region (shaped by patterns of colonialism and imperialism). It may also be incredibly hard for African researchers to be published in European scientific journals, due to cost and access. This becomes even more troubling given our findings about methods, in the next section.

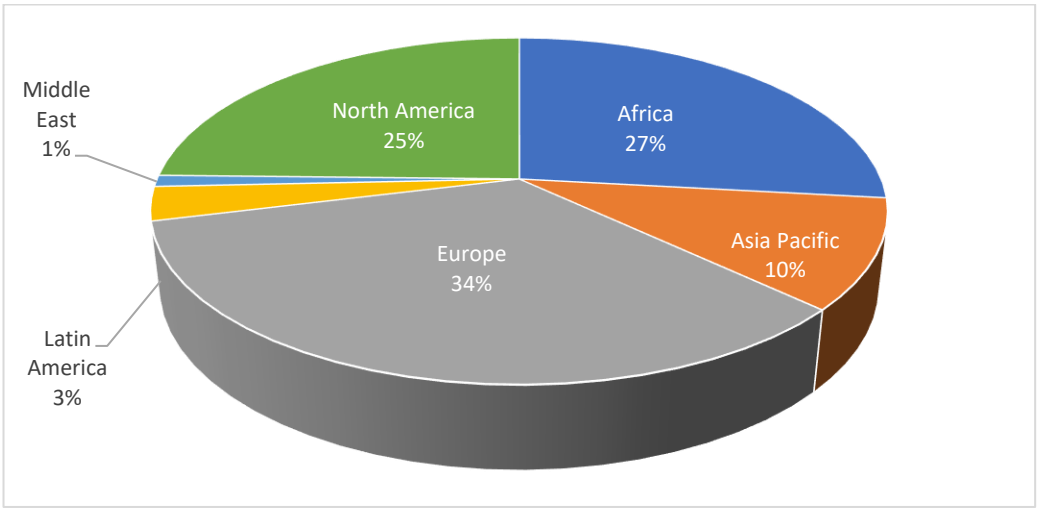



**Figure 5**. Author Demographics for Research on East African Electricity and Risk, 2012 – 2017. (Data derived by author).

### *3.2 Research methods and designs*

**Figure 6** reveals that while the most popular utilised method among all articles examined was a qualitative geographic case study, the second most dominant method was none at all —studies that had no detectable research design or methods section, commonly a non-systematic (convenience sample) literature review. Indeed, only a fraction of the sample (about 5%) utilised human centred, original data collection methods such as interviews, surveys, or experiments.

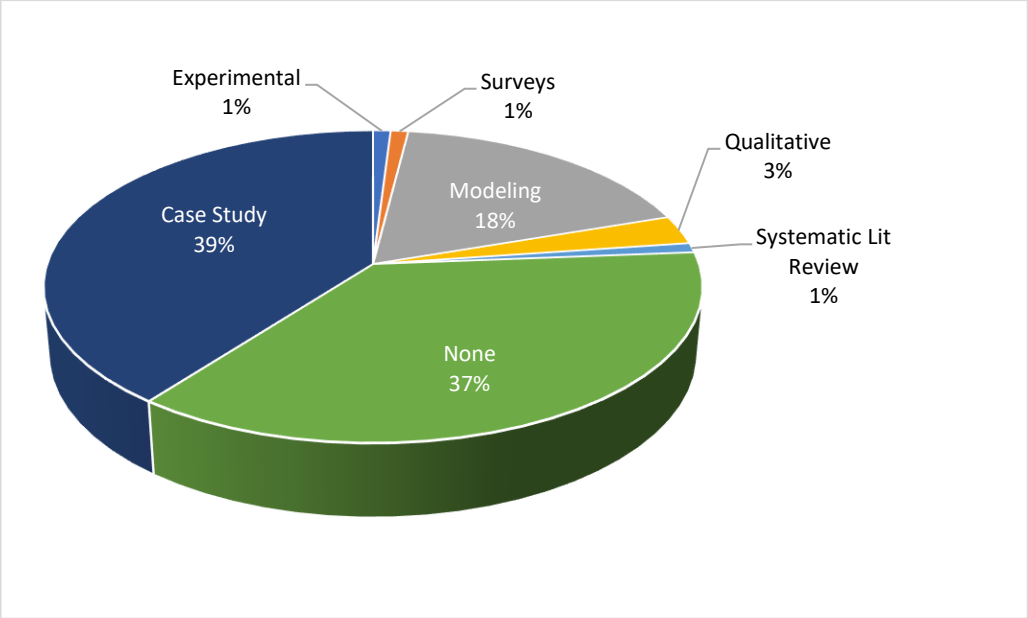



**Figure 6.** Research methods utilised by Research on East African Electricity and Risk, 2012 – 2017. (Data derived by author)

### *3.3 Themes and Topics*

Lastly, and perhaps most problematically, we find that the bulk of papers examined do not meaningfully discuss various elements of infrastructure development risk. As Table 1 summarises below, general risk and the causes or drivers of energy and electricity poverty are more frequently investigated; but access to financing, uncertainty, bankability, and policy mechanisms are not. For instance, only thirteen papers discussed the issue of how to facilitate access to finance as being the central challenge for resolving electricity poverty: Eberhard et al., 2017; Chirambo, 2016; Williams et al., 2015, 2016; Gujba et al., 2012; Onyeji, 2014; Labordena et al., 2017; Kagimu and Ustun, 2016;

Eberhard and Shkaratan, 2012; Eberhard, 2015; Doorsamy and Cronje, 2015; Ekholm, 2013; Ekouevi and Elizondo-Azuela, 2013.

**Table 1.** Scope of themes, topics and lacunae in research on East African electricity and risk, 2012–2017. (Data derived by author)

| Coding Category | Dimension | Number of papers addressing the dimension | Number of papers addressing the dimensions (%) |
|---|---|---|---|
| **3** | **Access to financing** | **12** | **11.9%** |
| **4** | **Uncertainty** | **2** | **2.0%** |
| **5** | **Risk** | **29** | **28.7%** |
| **6** | **Bankability** | **3** | **3.0%** |
| **7** | **Policy Mechanisms** | **13** | **12.9%** |
| **8** | **Causes of Poverty** | **69** | **68.3%** |

Only two papers discussed uncertainty and only one defined it: "the future evolution of relevant parameters, which cannot be derived on past observations" [Tinoco et al., 2012]. Twenty-nine papers discussed risk, but only five actually defined or conceptualized it: Labordena et al., 2017; Ogando and Pretorius, 2015; Tinoco et al., 2012; Ekholm et al., 2013; and Amars et al., 2017. Bankability of electricity infrastructure project proposals was only discussed three times. Types of electricity offtake agreements were discussed only 12 times: The causes of electricity poverty were most discussed, happening in 69 papers.

# 4. Discussion: framing, causality, and risk in energy poverty scholarship

As our systematic review indicates, the discussion of uncertainty and bankability within the literature is artificially narrow, and this appears to be due to the narratives utilised (alternatively with uncertainty, as its meaning can be quite subjective and varied, it could also be that the literature is just focussing on risk in different ways).

A public-sector perspective of electricity delivery is still the default narrative within the governments of Kenya, Mozambique, and Tanzania, as well as much of the academic literature. This is important: as the significance of uncertainty as a variable, and its impact, is completely different between a public and private sector context. Bankability as a variable is only relevant when applying a private-sector context. The standard default

perspective still assumes that a country's government will drive a solution to electricity poverty. However, the governments of Kenya, Tanzania, and Mozambique, do not have well-resourced balance sheets [CEPA 4, 2015]: for example, "Tanzania is one of the biggest recipients of donor aid of which a large share is going to general budget support" [Amars et al., 2017: 90]; Foreign largesse accounts for more than half of Mozambique's national budget" [Darley, 2012: 62]. Further, due a lack of institutional capabilities [Abramovitz, 1986], each country has a very inefficient tax collection regime, whereby they are not able to cross subsidise their electricity infrastructure through their tax system [CEPA 4, 2015]. The government narrative must be adapted therefore towards a private sector one, especially if the private sector is going to be successfully persuaded to finance these three countries' electricity infrastructure expansions. For privately sourced financing to be forthcoming for electricity infrastructure development in eastern Africa, the risk landscape must be able to fit within acceptable parameters. If it does not, such investment will not be accepted as an attractive commercial proposition – it will not be considered as 'bankable' – and there will be no 'private sector' participation. Therefore, we encourage academia to consider the following factors in this section.

## 4.1 *There is a need to widen electricity poverty themes, topics, and narratives*

When a theoretical explanation for electricity poverty in our review is presented, most papers adopt one of two systems approaches.

### 4.1.1 A Socio-technical systems narrative

Twenty-nine papers within the systematic sample, adopt a 'sociotechnical' narrative [Geels, 2004]: that attributes the problem of electricity poverty to a lack of demand or resistant regimes. This narrative suggests that within the three countries being analysed, there is a lack of household income (a social constraint), which limits demand for electricity as it cannot be afforded. This lack of demand in turn undermines the commercial basis for a supply of electricity from larger scale electricity infrastructure – the grid – resulting in a continuance of the electricity poverty. This narrative views finance as a limiting constraint that restricts the range of solutions to electricity poverty – much as the hours of sunlight are a constraint in generating solar electricity, or water hydrology is a limitation to the generation of hydroelectricity.

Solutions for electricity poverty within this narrative are therefore built around which technologies are possible to deliver electricity, within this financially-constrained environment. In the papers included in the systematic review, this usually involves the utilisation of small-scale distributive generation technologies [Ackermann et al., 2001], such as micro-grids powered by either small scale photovoltaic solar (PV) or Pico-hydro9 [Brix Pederson, 2016; Hofmeister et al., 2015].

### 4.1.2 A national innovation system narrative

Alternatively, twenty-four papers adopt a 'supply side' narrative that is determined by a 'national innovation system' framework approach [Freeman, 1995; Lundvall, 1985; 1992]. This perspective generally explains electricity poverty in eastern Africa as being the consequence of an inefficient and dysfunctional electricity services delivery systems: in the form of each country's electricity utility and surrounding government institutions, private enterprises and any other relevant actors [Eberhard and Shkaratan, 2012; Amars et al., 2017].

A national innovation system is a theoretical framework, that can be used to explain how a country's economic and political structure is organised to disseminate and operate complex technology [Freeman, 1995; Lundvall, 1985; 1992]. This framework is relevant to understanding a country's electricity service delivery network, as such networks are essentially the diffusion and operation of complex technologies. To function effectively, a country requires a minimal level of knowledge and capabilities between the relevant actors within the system [Ibid]. This would include shared perspectives, shared ambitions, compatible technical skills, compatible technology, and organisational standards within the system – at governmental, institutional and employee levels [Ibid]. Any dysfunctionality arises from poor structures of governance and levels of capabilities within the electricity system of each country [Abramovitz, 1986; Bell & Pavitt, 1993 Nelson & Winter, 1982] which when combined with other factors prevent the supply of affordable and reliable electricity.

The relevance of this theory focusses on each country's utilities inability to recover their cost of generating electricity when they sell it. This can be for several different reasons, but the most common ones given by the literature are:

[9] *Pico hydropower: Turbines smaller than 10kW are usually called "Pico". Pico hydropower is rarely fed into a power grid, but in most cases, electricity is delivered to a village or a workshop.*

- The retail tariff is to low [Eberhard and Shkaratan, 2012].
- There is a significant loss of electricity in the transmission system – as high as 25% in Tanzania [Amars et al., 2017] – before it reaches the customer;
- Customers do not pay their bills [Eberhard and Shkaratan, 2012].

A combination of these factors means that the utility is close to insolvency, and only manages to keep operating with ongoing government subsidies - which are never enough. This troubled condition then has a knock-on effect, due to too few resources to maintain and operate the system efficiently: there are no spare parts, and the infrastructure just wears out [Amars et al., 2017][10].

We advocate that both these narratives are too limiting in their explanation of the challenge.

### *4.2 Appreciate the relevance of finance and causality*

Even though both these narratives acknowledge that finance is a barrier to electricity access within the region, and in that sense in general agreement with study, they differ from our premise in their perspective of causality and the centrality and significance of this financing restriction. We postulate that electricity poverty in eastern Africa is as much an issue of causation as it is about the underlying challenges that impact access to electricity: what causes what to happen, rather than just a sum of everything.

Further, the ability to finance is a dependent variable that is determined by the many challenges (risks) that are listed in the literature: which are all independent variables. The dependent variable of finance in a way determines the severity and nature of impact of all the other challenges. To apply an analogy: the issue of electricity poverty in eastern Africa is like a large funnel that has a wide top and narrow neck. At the top, we can place all the uncertainties that negatively affect electricity infrastructure financing, that are listed within the academic literature (these are our independent variables).The ‘neck of the

[10] It should also be noted, as this wasn’t picked up in the systematic review’s literature (probably as it was then too recent a phenomenon in mid-2017), that the dramatic fall in the unit cost of solar PV produced electricity over recent years, is probably causing many past credit worthy customers of the utility in the three sample countries, to rapidly abandon their country’s utility as customers [IEA, 2019]. This reality is likely to be placing further financial strain, on each of the three country’s utility’ finances.

funnel' represents the ability (or inability) to finance the building of new electricity infrastructure (a dependent variable).

We can potentially widen the neck of the funnel by either managing the current independent variables, by reducing their risk; or by being able to redefine the independent variables, by changing them for something with less uncertainty. As an example: governance issues surrounding the development of electricity infrastructure in eastern Africa primarily undermine the ability to finance such development, rather than the development process directly.

## *4.3 A better understanding of risk*

Further we argue that the academic community must come to assess more dynamically (and grapple with) risk. We give six examples of different dimensions of risk that require more analysis that is rigorous: planning risk, construction risk, operational risk, stakeholder risk, meso or country risk, and macro or systemic risk (with Table 2 offering an overview summary). In this classification, we have utilised a limited amount of additional academic and grey literature for citation purposes, to fill evidence gaps in the systematic review literature.

**Table 2.** Overview of risks to electricity financing in Sub-Saharan Africa. (Data derived by author)

| Category of Risk | Description | Degree |
|---|---|---|
| Planning | Planning, licensing, or approval costs and delays | High |
| Construction | Engineering, procurement, and construction costs for both fossil fuelled and renewable electricity infrastructure. | Moderate |
| Operating | Unexpected changes in performance, credit, regulation, and security. | High |
| Stakeholder | Individual, group, or organisational actors that can affect a project. | Moderate |
| Meso/Country | Changes in capabilities, policy regimes, governments, or complimentary assets. | High |
| Macro/International | Global interest rates, appetite for long tail liquidity risk, or exchange rates | High |

### 4.3.1 Planning risks

The two principal negative features connected with the planning of infrastructure in the region are related to the amount of time taken (an associated cost), and the actual cost of dealing with the level of red tape, that surrounds the infrastructure development process

in all three countries. Both these issues are closely related and will be dealt with together. They stem from the lack of institutional capabilities, which our sample country suffer from, and governance issues [Collier, 2014; Amars et al., 2017]. The lack of institutional capabilities result in macro sociological and institutional barriers, which prevent the successful adoption of new technologies by a less developed economy [Abramovitz, 1986; Bell & Pavitt, 1993]. These arise from deficient skills, processes, and knowledge, which prevent the successful diffusion of technology, which is what electricity infrastructure would qualify as.

The infrastructure planning process for electricity in eastern Africa is considerably more risky and costly than its OECD equivalent. Planning costs can be as high as 10% of the project value, in contrast to the OECD standard of under 1% [Castalia, 2014:21]. This is partly due to a lack of available of institutional expertise within the government, but also mischievous 'rent-seeking' [Krueger, 1974] from politically connected individuals, who use their 'power to delay' to extract an 'advantage', particularly in Tanzania and Mozambique [Amars et al., 2017; Kihwele et al., 2012; Darley, 2012]. It can also be very difficult and expensive for an international investor, to obtain the necessary expertise that is appropriate for each country.

This absence of institutional capability and governance adds to planning costs in two ways, as the government is responsible for both creating and authorising infrastructure schemes [CEPA 1, 2015]. Poor institutional capability within government, results in a deficient formulation of tenders, as there is little comprehension of investor prerequisites – for example, there are no set standards for structuring projects: "the supporting legal documentation for the off-take agreement in a recent Kenyan electricity project was a thousand pages long, resulting in prohibitive costs" …… . "The equivalent in India would likely be only 20 pages" [Collier, 2014: 40].

There is also a lack of capacity to swiftly evaluate the requisites and suitability of a project proposal and its accompanying documentation, largely due to a bureaucratic structure, where a complicated administrative process stalls everything (even without mischievous motivations). The Lake Turkana wind farm project in Kenya, the largest in Africa, took far longer to reach financial closure than would be normally expected in other, more developed jurisdictions [CEPA 3, 2015]. The total number of proposals also overwhelm the bureaucracy, many of which are unsuitable for purpose. Kenya is better

in this area than Mozambique and Tanzania, where its governance is improving [CEPA 2, 2015; CEPA 3, 2015].

Applying our classification process discussed in *sec.2.1*: we give these risks a high rating: despite these risks being proportional, we give them a high rating because they can stop an investment evaluation from ever happening, and they a high probability of occurring.

### 4.3.2 Construction Risk

Construction risks are negative factors that are attributable to the physical construction of an electricity infrastructure asset. These can be reduced into two elements: the technology being utilised within the asset; and the contractor that is responsible for the asset's construction.

***Technology risks*** surround the implementation and operation of the relevant technology to be utilised to generate electricity, which we subdivide into the traditional fossil fuel technologies and renewable technologies. We note the strong academic debate over which technologies should be utilised when developing electricity infrastructure in eastern Africa, due to climate change. To reflect this as well as for clarity of explanation, as both technology risks have different causalities, each will be reviewed separately.

***Fossil fuel technologies*** are better understood in SSA and therefore are not regarded as problematic – as such, they are easier and cheaper to finance. They are however more expensive to operate, due to their need to obtain feedstock (coal, oil, etc.); and this is a burden not just because of the cost of the fuel, but because that requires ‘hard’ currency (This will be discussed later under currency risk, which will be within the macro-risk section). Currently diesel generation is the major fossil fuel utilised for this reason, as it is the most flexible and cheapest technology to install, despite being the most expensive to operate, when compared to other technologies on a variable cost basis [Eberhard and Shkaratan, 2012; Labordena et al., 2017]. Mozambique has proven rich coal reserves, and all three countries have likely offshore gas reserves. These are yet to be fully exploited however, as governance issues are slowing the progress of this development [Robbins and Perkins, 2012]. The existence of this resource has created a bias within Mozambique and Tanzania towards fossil fuels, particularly as they do not yet see climate change as being an African issue [Amars et al., 2017; Kihwele et al., 2012].

Different renewable technologies, differ in their risk profile, which makes it necessary to split traditional hydro from modern geothermal, solar and wind technologies. Hydro technologies have been the backbone of all three countries electricity systems since their colonial independence, after being installed by each country's previous colonial administrations. Each system is suffering performance issues however, through poor maintenance [Adebayo et al., 2013; Eberhard and Shkaratan, 2012]. The future of hydro in the region is now also very questionable, due to climate change, which has negatively influenced the regions hydrology and completely upset the technology's viability – particularly in Kenya and Tanzania [Amars et al., 2017].

The unique hydroelectric arrangements in Mozambique deserve special note: Cahora Bassa is the country's principal hydro dam (which is located on the Zambezi river), which is responsible for over 95% of the country's electricity generation. More than 90% of the electricity generated from this dam is exported, as this was a necessary requirement to finance construction [Isaacman and Isaacman, 2015]. This issue clearly demonstrates the compromises that finance issue can lead to in the region.

The risks surrounding other renewable technologies can be attributed to a high fixed upfront cost, which makes financing more expensive; and issues of capabilities when it comes to construction, operation, and servicing - as these are seen as new and unfamiliar technologies that require expensive overseas-trained labour forces. Expensive foreign expertise will have to be hired in, to implement the new technologies, but this can then create issue of friction politically with stakeholders, particularly over the longer term, as client countries in African sometimes demand the utilisation of a local workforce [Baker and Sovacool, 2017]. This can also lead to security issues (see below) [Eberhard and Shkaratan, 2012]. This then creates long-term performance risk, another important factor in being able to obtain finance [Labordena et al., 2017].

In conclusion: both the governments of Tanzania and Mozambique favour the use of fossil fuel technologies, for the development of electricity generating infrastructure, as they have lower development costs and associated complications than renewables. Kenya, which is far more sympathetic to climate change, favours the use of renewables, particularly geothermal [CEPA 3, 2015]. The academic literature, as witnessed in the systematic review, has a definite positive bias towards the use of renewable technologies for the future of electricity generation in eastern Africa – due to the above technology

familiarity and lower financing costs, this debate cannot be regarded as a settled [Labordena et al., 2017].

***Contractor risk*** encompasses whether a contractor that is constructing the asset on behalf of the investor, can fulfil their contractual obligations: in terms of robustness, quality, cost, and timeframe – that has been itemised and accepted in the contract. If the contractor has experience in the region and the technology to be utilised, these risks should be proportional and of a low probability – but eastern Africa is a very challenging environment. It is standard practice for contractors to give performance guarantees with their work, within their contractual arrangements. There are also many financially well-resourced engineering firms, which are interested in carrying out such work – so if proper 'due diligence' is carried out when appointing a contractor, this will minimise such risk.

Applying our classification (*sec2.1*) – Together, we give these risks a moderate rating: despite these risks being absolute and having a high impact, the option of choice of both technology and contractor allows for some degree of risk transfer and avoidance.

### 4.3.3 Operating Risk

Operating risks directly influence the revenues of the new infrastructure once it has been commissioned. They can be sub-divided into four groups:

- Performance - will the technology function in the way it was engineered to do.
- Credit - will the anticipated buyer of the electricity pay the anticipated price in a timely fashion.
- Regulation – will the expected output and tariff be free of inappropriate political interference.
- Security - will the asset's essential personnel be safe from physical interference, and will the physical asset be safe from theft and vandalism/terrorism.

*Performance risk* has already been discussed as part of technology risk in the previous section – so, this will not be analysed further here.

*Credit risk* can be attributed to each country's electricity utility's ability to pay its bills. In our sample countries, their utilities have monopoly rights to distribute electricity to customers in terms of the main grid where larger scale customers will be located [CEPA 2, 2015; CEPA 3, 2015; Amars et al., 2017]. Consequentially the country's utility will be the customer for any electricity generated – but none of these utilities has an investment

grade credit rating and therefore cannot be considered a credit worthy counterparty [CEPA 2, 2015; CEPA 3, 2015; Amars et al., 2017; Eberhard and Shkaratan, 2012]. A standard way around this is for the actual government to offer guarantees, but Kenya only offers these sparingly – it partly did so with the Lake Turkana wind farm project – and both Tanzania and Mozambique have both refused to do so [CEPA 2, 2015; CEPA 3, 2015; Amars et al., 2017]. This poor credit rating also makes the credit management tool of 'Power Purchase Agreements' (PPA) in this environment ineffective [CEPA 4, 2015]. Regulation risk in all three countries is expressed through tariff restrictions, because of political lobbying (particularly from business) to keep electricity prices low [CEPA 1, 2015; Eberhard and Shkaratan, 2012]. These tariff rates are currently below the cost of generation – so when you consider there are substantial losses of electricity in the transmission process, 25% in Tanzania [Amars et al., 2017]; and a significant failure of customers paying their bills [Amars et al., 2017; Kihwele et al., 2012; Eberhard and Shkaratan, 2012] – this is a major negative factor for investment. The only reason each utility is still solvent is through government subsidies from general revenues (and aid). Therefore, whilst tariff limits are in place, any increase in access to each country's grid will put further financial pressure on each governments balance sheet (particularly as the incremental cost of the new supply, will be much higher than the existing supply) [Eberhard and Shkaratan, 2012]. It should be noted that this is a policy that favours the country's urban elite, as the rural poor do not have any access to electricity that is subsidised [Eberhard and Shkaratan, 2012: citing Fritz et al., 2009]. Security risks are factors that affect both the asset and key staff.

Assets can be damaged through acts of terrorism or criminality; key staff are increasingly under threat of kidnapping for ransom. Some examples would be: in Mozambique, RENAMO[11] have threatened to resort again to conflict, although they did sign another peace agreement in May 2017 – during the country's civil war post-independence, when RENAMO was a party to the conflict, the Cahora Bassa hydro-electric project's transmission infrastructure was continually attacked by them [Isaacman and Isaacman, 2015]. In Kenya, transmission infrastructure is continually vandalised (particularly by aggrieved stakeholders) or has electricity stolen from it; key personnel are subject to kidnapping [Gumbe, 2016].

[11] RENAMO is Mozambique's principle political opposition, which evolved from one of the country's previous civil war antagonists.

Applying our classification – We give these risks a high rating: both impact and probability are high, due to the likelihood of the four sub-factors working in combination.

### 4.3.4 Stakeholder Risk

Stakeholders in our context are any significant individual, group, or organisation that has both an interest and an ability to influence the development of an electricity infrastructure project [Hillson, 2004]. Stakeholder influence is not necessarily specific to any stage of the development process, and it can be either proportional or absolute in its impact, depending on the level of power and willingness to wield it. A relevant government minister could be absolute in impact, if they chose to nationalise an asset for instance; a bureaucrat could be very troublesome, but in a more measured way. Examples of stakeholders include senior government ministers, government bureaucrats, infrastructure effected populations, business customers, residential customers and donors. Their capturing qualification is that they are all impacted in some way by the existence of electricity infrastructure; all have a legitimate interest in its operation, and all can negatively influence it if they feel the need to do so. Therefore, if they are not appreciated and managed, they can be very troublesome [Hillson, 2004].

Many of the stakeholder issues will be covered under meso-uncertainties in the next section, under political risk.

Applying our classification – We offer a medium/high rating for these risks: their impact is proportional and medium, but the probability is high.

### 4.3.5 Meso or country risks

This ‘field’ of risk is specific to a country and its institutional and social structures, which are often to do with issues of governance. Four primary meso risks exist: *capability, legal/regulatory, political, and complimentary assets*.

*Capability risk* has already been partly discussed under planning uncertainty; and the remaining aspects will be assessed in the macro risks section, where it creates exchange rate structural risks – so these risks will not be analysed further here.

*Legal/regulatory risk* have been mostly covered already in earlier sections and are intuitive in nature – so these risks will not discuss further.

*Political risks* are primarily issues of governance that arise from neo-patrimonialism, which is a predominant governance model to SSA. The governing elite's need to finance a political patronage system to maintain control of the political structure that delivers benefits to those that administer it [Bratton and Van de Walle, 1994; Erdmann and Engel, 2006], brings about acts of financial misappropriation through informal 'rent-seeking' [Krueger, 1974], which is facilitated by an abuse of asymmetric power. The electricity infrastructure business model is not sufficiently robust when faced with any sizable rent seeking, due to the already discussed acute tariff regulation, and is vulnerable to becoming un-commercial when consistent illicit demands are placed upon it. As foreign investment in SSA is normally associated with the high 'rent' carrying business models associated with resource extraction, it is unclear how comprehensively SSA 'policy actors' appreciate this financing vulnerability (or care) that is applicable to electricity infrastructure projects.

Applying our classification – We give these a high-risk rating, as neo-patrimonialism is embedded in each country's political system, and the business model of electricity infrastructure is not always robust enough to absorb any illicit payments.

*Complimentary assets* [Teece, 1986] are structural factors, which are essential for enabling the electricity infrastructure to create and appropriate value. They can be absolute or partial in their impact, as without them the principal asset would not be able to operate effectively. They are often physical assets but can also include structural processes.

The most significant of complimentary asset issues result from the embedded nature of electricity infrastructure. Unless a small-scale distributive technology is being utilised (such as home solar), electricity infrastructure can be divided into three separate components. Electricity generation, the creation of electricity from an alternative form of energy such as wind (kinetic energy) or coal (potential energy); electricity transmission, the grid that utilises pylons and wires; and local area distribution, the connectivity between the closest electricity substation and a home. It is not just the existence of these separate components, but also how effectively they are operating that makes them complimentary to each other.

In all our three countries, as already mentioned earlier under the operational uncertainties, the transmission infrastructure and local area distribution network is the

responsibility of the country's national utility. The commercial viability of these utilities is questionable and the performance of the transmission assets unreliable, Tanzania loses 25% of the electricity generated through its transmission infrastructure [Amars et al., 2017]. This makes the uncertainty that surrounds the availability of efficient complimentary infrastructure in eastern Africa substantial – even when/if they are promised during planning.

Further examples of complimentary assets would be effective hydro generation requires water sources to be dammed and flooded, with affected populations to be relocated. A solar photo voltaic (PV) power station necessitates that its PV panels are not stolen. An efficient tendering process requires standardised and comprehensive paperwork, which efficiently sets out required guidelines; effective payment for electricity used requires an effective billing system.

Applying our classification – We give these risks a medium rating: responsibility for their supply relies on the country's institutions and the commerciality of any new infrastructure is completely reliant on it – however, these risks can often be identified in advance and planned for.

### 4.3.6 Macro or international systemic risks

In our three countries, the domestic banking system is mostly too undeveloped to finance any significant value of electricity generation infrastructure projects, although Kenya has enjoyed some success [CEPA 3, 2015]. However, for the private sector too fully or effectively finance infrastructure it will require facilitation from the international financial markets. This will then expose electricity infrastructure development, to international systematic financial risks.

There are at least three key variables that need to be appreciated from this risk field. First is *international interest rates* - which will determine the rate of return the investment will demand. Interest rates affect all private sector investments in that they determine the 'benchmark cost' that finance will be available for infrastructure development. On top of this 'benchmark', is then added the risk premium demanded for the country and project uncertainty – known as the Weighted Average Cost of Capital (WACC)[12]. If both these

[12] WACC - Weighted average cost of capital (WACC) is a calculation of a firm's cost of capital, in which each category of capital is proportionately weighted to represent its relative risk to its alternative uses and its absolute risk profile [Garcia, 2017].

figures are high (assuming there is still a willingness to finance within eastern Africa), this required return is likely to be too great, for the underlying commerciality of the project.

Second is a *long tail liquidity appetite*, the financial markets inclination to hold long dated illiquid investments. This is a measure of the sentiment of the financial markets: whether they are 'bullish' or 'bearish', to use a 'markets' cliché. Infrastructure investment by the private sector requires long time horizons to function: usually more than 20 years. If the markets are bearish (pessimistic), it is unlikely that market sentiment would enable long-dated investments in eastern African electricity infrastructure to occur. As a 'rule of thumb', the more bullish (optimistic) the markets are, the more willing they are to finance such investments.

Third is *exchange rate risk*, or how much value is potentially at risk in the repatriation process of the value of the investment. Our three country's currencies are classified as 'soft', which means they are illiquid and not easily transferable in large value transactions. Such characteristics create significant negative uncertainty for the revenues to be received in the borrowed hard currency, which can be reduced sizably from the nominal level during the conversion process, obstructing the willingness to finance. This issue can then be compounded by exchange controls, which prevents any repatriation of money from the country. Mozambique currently has such restrictions, where unless the funds have been earned through export, they cannot be repatriated from the country [Amars et al., 2017]. Such restrictions would affect electricity infrastructure investments, as their revenue would be domestically sourced.

Clearly, the threat of not being able to repatriate both the initial investment value and any anticipated profits, is an investment killer – as this removes the *raison d'être* of most foreign sourced investment. This is a factor that is rarely considered by the development literature – exchange risk was only mentioned in 6 of the 101 papers reviewed, as part of the systematic review.

Applying our classification – We give these risks a high rating: the three factors in combination will ultimately determine whether an infrastructure project can be internationally financed.

# 5. Conclusion

This study accepts that causes behind electricity poverty in eastern Africa are many and complex, with numerous variables negatively affecting the delivery of electricity in the region. Rather than supposing that the obstacles identified in the literature result in electricity poverty directly, instead we argue that they are independent variables that control the ability to finance the construction of new electricity infrastructure – their impact is therefore indirect. This means that a standard systems narrative is an incomplete explanation of electricity poverty, which instead needs to be broadened to include uncertainty and its impact. In sum: the academic community, and the policy regimes that it informs, needs to adopt a more complex and dynamic approach to financing electrification.

Further, our study notes a lack of authors writing on this subject are located within eastern Africa (only 27% of our sample), and a paucity of human centred methods (fewer than 5%) such as original data gleaned from interviews, surveys, experiments, and other stated preference techniques. Worryingly, more than one-third of articles examined (37%), had no formal method at all. This suggests the energy studies academic community needs more inclusive yet robust and rigorous research, a finding also noted by Sovacool [2014b] and Sovacool et al. [2018].

Lastly, as evidenced from our systematic review, much of the development literature sees the financing of electricity infrastructure in eastern Africa as a fixed and peripheral constraint, which is limited by low household incomes. Instead, we argue that the ability to finance is a limiting factor whose confines can potentially be alleviated when they are fully understood, and then managed. As such, they are potentially resolvable or at least relievable.

For if this understanding of the causes of electricity poverty in eastern Africa can be appreciated and be incorporated into policy: then meaningful progress can be made in reducing this electricity poverty. This is the goal of this study – to redirect the policy debate so that finally the eastern African region can enjoy access to reliable and affordable electricity, and consequently more meaningful and sustainable economic growth.

# Chapter 4:

# *Rethinking the governance of energy poverty in sub-Saharan Africa: Reviewing three academic perspectives on electricity infrastructure investment*

## Abstract

Since the 1990s, the World Bank and other relevant and respected multilateral organisations have consistently advocated that the required finance to develop sub-Saharan Africa's essential electricity capacity should be sourced from the private sector. However, despite this ongoing advocacy, the private sector has been unenthusiastic to answer this call. Much of the literature attributes this reticence to a lack of 'good governance': principally negative behaviours such as corruption. Instead, in this paper we argue that this is too simplistic an explanation, as private investment has still been able to thrive in other locations where such negative behaviours have existed. To support this argument, we utilise an interdisciplinary approach to review three separate academic governance perspectives, to deliver a more comprehensive view. These are: 1) Financial Investment Governance, the private sector investor's perspective, which focuses on the rules and institutions (or lack of) that directly, influence the financial investment environment. 2) Political Governance, the political economy perspective, which relates to the negative, indirect investment consequences resulting from the way that governments govern; and 3) Technical System Governance, a 'systems' perspective, which encompasses how the standard structure and organisation of the wider electricity delivery system in each country, negatively impacts such investment. In the discussion and conclusion, we find that if the development policy perspective for delivering electricity access to the region is to be successfully constructed around private investment, as the multilateral development community advocates, it will need to accommodate 15 distinct issues that can be identified from this comprehensive review of governance.

# 1. Introduction

This paper revisits how governance theory explains why the private sector has been unenthusiastic towards investing in Sub-Sahara African (SSA) electricity infrastructure, by applying a multidimensional application of governance, which uses interdisciplinary perspectives. We do recognise that there has been a recent growth in private sector investment interest, through independent power producers (IPPs) in the region [Eberhard et al, 2017]. However, this has been from a very low base and has a bias towards South Africa and partially Kenya, which are regional statistical outliers.

Electricity capacity growth rates in sub-Saharan Africa, not including South Africa (RSA), over the last 40 years have been half those found in other developing regions [Eberhard & Shkaratan, 2012]. Holstenkamp [2019] writes that 95% of the population without access to modern forms of energy live in developing Asian and African countries, and that 'the challenge is considerable, especially in sub-Saharan Africa.'

Historically, Official Development Assistance (ODA) was used to finance electricity capacity growth in SSA, but ODA was never able to deliver the level of resource that was required to satisfy the scope of this investment need. Towards the end of the last millennium, expectations shifted under Wolfensohn's presidency of the World Bank: so that the dominant multilateral development narrative surrounding financing, became a private sector sourced one [Collier, 2014; Eberhard, 2015]. Since then, both senior personnel and policy papers from the World Bank and other respected multilateral organisations, have repeated this call for the private sector to finance SSA electricity capacity growth [AfDB, 2010; Africa Progress Panel, 2017; G20, 2017; World Bank 1, 2017; World Bank 2, 2017; World Bank 3, 2017; World Bank, 2011; World Bank, 2010]. However, despite these constant calls for support, the private sector continues to show a dearth of enthusiasm for investing in SSA electricity infrastructure development projects – ignoring the current generationally low global interest rate levels and a recognisable desire from the international financial markets for investment opportunities surrounding infrastructure.

This private investor reluctance is recognisable by the lack of SSA sourced 'Clean Development Mechanism' (CDM) projects that have been registered, whilst conceding the technology restrictions of this measure. The CDM was designed in 2007 and is a market-based mechanism designed to elicit private sector participation: yet by the end of

2014, the SSA region represented only 0.63% of the total of CDM projects globally [Kreibich et al, 2016]. This is despite the financial markets – consisting of pension funds, insurance companies, sovereign-wealth funds, mutual funds, (to name the major constituents) – having more than 100 trillion $US in assets under management to invest [Arezki, R. et al, 2016; Gregory & Sovacool, 2019a]. With this level of resource, and the clear investment need for such infrastructure to be developed within SSA – a lack of enthusiasm could still be argued to be a generous description of the private sector's unwillingness to invest.

Governance – a term that encompasses factors such as accountancy and institutional capacity, political stability and bureaucratic flexibility – can play a vital role in shaping the direction and scope of private sector investment [Zaman & Brudermann, 2017]. Yadav et al. [2019: 1] even go as far as to write that a transformation of 'governance models are required to meet the needs of communities living in rural and remote areas and particularly for those subject to energy and economic poverty.' Yet many approaches to 'governance' oversimplify the extent of the challenges and tend to ignore the polycentric or systems level complexity that cuts across the actors, networks, and knowledge structures needed to address poverty [van Noordwijk, 2019].

Traditionally, when the literature utilises 'governance' to explain why the private sector is unenthusiastic for investing in the region's electricity infrastructure, it often applies a narrow interpretation that centres on negative behaviours such as corruption. As private investment has still been able to thrive in other locations where such negative behaviours have existed [Booth, 2012], we challenge this view and argue that the literature is too narrow in its governance focus. As a decision to invest is a function of risk and reward [Bessis, 2015; Dixit & Pindyck, 1994; de Jager & Rathmann, 2008], we instead contend that the lack of investment interest is a result of a financing 'market failure' related to excessive 'negative uncertainties' or risks[13]. Further, these risks derive from the indirect unintended consequences of the governance process, rather than the governance process itself. To do this, we utilise three separate academic perspectives to build a more holistic picture of how the current governance application surrounding the

[13] In this paper, both 'uncertainty' and 'risk' refer to the factors that cannot be pre-determined and can negatively affect an investments performance. It is accepted there is a degree of ambiguity and subjectivity surrounding the exact meaning of both these terms – within the financial markets (as this is a paper concerning private investment) and within the project management academic literature, the term 'risk' is usually regarded as being interchangeable with 'negative uncertainty' [Bessis, 2012; Chapman & Ward, 2011; Hillson, 2004].

development of electricity infrastructure contributes to risk. In this paper, we call these three perspectives:

- **Financial Investment Governance**: the private sector investor's perspective, that focuses on the rules and institutions (or lack of) that directly influence the investment environment in SSA.
- **Political Governance**: the political economy perspective, that focuses on the indirect investment consequences resulting from the way that SSA governments govern.
- **Technical System Governance**: a 'systems' perspective, which encompasses how the standard type of structure and organisation of the greater electricity delivery regime in SSA, negatively impacts such investment.

Before scrutinising each of these perspectives: first we define what is meant by 'good governance' in this paper, as there is no common definition of the term and it is often ideologically charged [Hufty, 2011]. We then explain what is meant by private investment. Next, we clarify why investors invest. Finally, we summarise the standard characteristics of this type of infrastructure investment and we explain how negative uncertainty deters investment.

To define our three academic perspectives, an extensive interdisciplinary literature review was conducted, principally integrating insights from across four separate academic disciplines: investment finance, project management, development studies, and innovation studies. The investment finance literature contributed to dimensions such as why investors invest, why excessive negative uncertainty deters investment, and outlines the parameters of investment governance. The project management literature furnished its theories on risk: as most electricity infrastructure is developed through projects and risk forms a major part of that discipline's theory. The development studies literature supplied its theories on political economy; and data for the three perspectives. The innovation literature offered its theories on systems and regimes; and the 'diffusion of technology', as electricity infrastructure development is essentially about socio-technical transitions.

# 2. Conceptual approach and key terms

Here, we introduce readers to three core concepts or terms used throughout the article*: good governance, private investment,* and *risk.*

## *2.1 Grappling with good governance*

Governance broadly refers to any of the multitudinous processes or institutions in place, by which people set and enable rules needed to reach desired outcomes [Florini & Sovacool 2009]. While most commonly envisioned as the domain of governments, many other actors are involved in governance, including civil society organisations, corporations, and institutions of finance.

Governance, when it concerns SSA, is often applied narrowly, negatively, and ideologically as a description of an act of financial misappropriation [Hufty, 2011; Booth, 2012], through a 'principal-agency' framework [Eisenhardt, 1989]. Such misappropriation is possible through the abuse of a power asymmetry, often held by individuals on behalf of the structure of state: this imbalance is then used to obtain a non-state obligatory financial gain [Levy, 2014]. Although this is a legitimate perspective of governance in our context, it represents only a small part of the theoretical lens that shapes the governance matrix that we use in this paper. Instead, we apply the term governance less rigidly and ideologically, using a much wider definition and utilising different stakeholder perspectives.

Firstly, our definition of governance will apply a systemic approach: encompassing interactions and decision-making among all the various relevant stakeholders, reflecting the gradients of power and influence, involved in a collective problem – that being in this paper, the development and operation of electricity infrastructure within SSA. These interactions then lead to the creation or reinforcement of rules and social norms, along with accompanying institutions [Hufty, 2011]. Secondly, governance efficiency and sustainability (good or bad) is determined by its ability to deliver acceptable outcomes for all the relevant stakeholders, by successfully aligning stakeholder interests [Freeman R.E. et al; 2004].

We argue, that the principal reason there is so much ambiguity in establishing what 'good governance' entails and the reason for the apparent obstinacy in achieving it in a SSA context, is due to its effectiveness being normally defined from the perspective of

the stakeholder that is applying it. In other words, it is normative in its application [Hufty, 2011]. This dichotomy is quite easy to observe in our field of study, by the apparent conflict of application between the interests of SSA national governments and those of the external financial donor countries over accusations of corruption.

As successful electricity infrastructure development is supposedly the desired outcome for all stakeholders, all sponsors apparently want the successful delivery of affordable and reliable electricity – good governance should not in fact be the issue at all. The reason that it is we argue, is because the negative impact of the unintended consequences of governance outcomes, are not equally appreciated by all stakeholders and the benefits of such development are being contestably apportioned. Good governance is in fact a 'collective action' problem [Booth, 2012]: achieving it requires a holistic understanding of what it should entail for all relevant stakeholders, and agreement about its fairness by all sponsors in its application. Good governance, therefore, requires a belief in its legitimacy [Tyler, 1990].

### *2.2 Conceptualizing private investment and how it is impacted by risk*

In most of sub-Saharan Africa (excluding South Africa), the domestic banking system is not able to privately finance any significant capacity increases in electricity infrastructure; compounded by there being few significant corporate, non-government institutional, or 'private office' investors in the region [IFC, 2016; Gregory & Sovacool, 2019a; Sovacool & Cooper, 2013]. Therefore, in the context of this paper, private sector investment will refer to internationally sourced (out of region) private investment.

Applying Occam's razor: an investment can be defined "*as the act of incurring an immediate cost"* (the value of the investment) "*in the expectation of future rewards"* (the investment return) [Dixit & Pindyck, 1994:3]. This definition suggests that there are two related, but separate elements involved in an investment; and that investors require certainty of outcomes from the second element, in response to the first.

A decision to proceed with an investment is also a relative decision, as any individual investment opportunity does not exist in isolation: there are always many alternative investment opportunities that exist [Bessis, 2015; Dixit & Pindyck, 1994, de Jager & Rathmann, 2008]. This means that there exists an opportunity cost when investing in

electricity capacity in SSA, as the financial resources of that investment can no longer be utilised elsewhere. Investors will therefore discount the perceived future rewards of an investment, in response to any risks that can affect those rewards. Further, an investment in the development of new electricity infrastructure in SSA will be illiquid – meaning that such an investment cannot be easily removed, sold, or exchanged for cash, without a potential significant loss of value [Longstaff, 2001]. In any sort of electricity infrastructure development in SSA, the investment's value will be tied to the location that the asset has been constructed within (the asset cannot simply just be removed and taken away intact) [Levy, 2015]. The only way therefore for the investment to realise its value as an investment, is for it perform as it was intended when the investment was planned. Additionally, infrastructure investments of this type need to be long dated, usually more than 20 years; and if their tariffs are correctly set and regulated, such infrastructure will represent a 'normal' margin business[14], without excessive profitability [UNCTAD, 2017].

### *2.3 Consequences of risk through optionality cost and reward*

So, when applying an investment's relativeness, illiquidity, normal margins, and long dated timeframes into account – a private investor's willingness to proceed with an investment opportunity, will be determined by the perceived level of 'negative uncertainty' or risk that surrounds the ongoing value of their immediate cost of entering that investment and the likelihood of attaining the expected future rewards [Bessis, 2015; Dixit & Pindyck, 1994; de Jager & Rathmann, 2008; Garcia, 2017; Longstaff, 2001].

Risk affects a decision to progress with an illiquid investment in three ways: it firstly delays a decision to proceed, by amplifying the value in deferral (a type of optionality). Secondly, it forces an investor to discount the future rewards for participation, which both reduces the desire to proceed and makes alternative investment opportunities relatively more attractive; and thirdly, it discourages opportunity evaluation by professional investment managers.

In SSA, from the private investor's point of view, there is no urgency to invest – as there are many more electricity projects needing investors, than investors needing

[14] **Normal Margin** is determined by a 'benchmark' interest rate such as London Inter-bank Offered Rate (LIBOR), plus a weighted average cost of capital (WACC). WACC is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted, to represent its relative risk to its alternative uses and its absolute risk profile [Garcia, 2017].

electricity projects. If we treat the ability to delay an investment, as being 'like having the right to choose when to invest at some point in the future'– we can place a value on that right to delay, by treating it as a synthetic option which has a value[15] [Dixit & Pindyck, 1994]. This 'optionality' value will then cease to exist once an investment proceeds – just as a normal option ceases to have value once it is exercised. Therefore, proceeding with an investment, destroys the synthetic options value. Further, the more risk that surrounds an investment, the greater the value that can be implied to the right to delay the commencement of an investment [Dixit & Pindyck, 1994, Hull, 2018].

As an investment is a relative decision, investors will discount the perceived 'future rewards' of an investment in SSA in response to excessive negative uncertainty (in SSA, often to zero), against any alternative opportunities that are not so burdened. Risk makes the investment a less/un-attractive proposition. In response to risk, either investors will demand a higher return, undermining the project's commerciality and attractiveness as an investment; or they will just invest elsewhere, probably in an unrelated location [Dixit & Pindyck, 1994; Longstaff, 2001].

We also need to appreciate how excessive negative uncertainty influences the evaluation methods of the actual private sector investment management teams. In the competitive, highly paid 'job market' that is the finance industry – an investment manager can expect to lose their job if they make flawed investment decisions, particularly ones outside customary investment parameters which are illiquid [Longstaff, 2001] – colloquially termed: *moving away from the heard*. Equally, there is also an expectation of quality productivity: they are not expected to forever evaluate investment opportunities, without proceeding with some of them. For ongoing employment and productivity reasons therefore, investment managers prefer to evaluate opportunities with

[15] **A financial option** is a form of 'financial derivative':

- It is a standardised contract, which is derived from the existence of an '*underlying financial instrument'*: such as an equity, bond, or currency.
- It grants the owner of the option, either a right (but not an obligation) to buy or sell the underlying financial instrument before and/or at a '*point in the future'*, for an agreed price and terms.
- This delayed right to buy or sell **has a value**, which can be calculated using a formula (commonly using an algorithm, known as Black and Scholes[15]).

The option ceases to have value, after either it is exercised, or when it expires when the 'point in the future' is past. The options value both increases and decreases, with the level of risk over the price of the underlying financial instrument (*volatility,* in options language).

A **'synthetic'** option is a situation that presents the same characteristics and opportunities as those offered by a physical option: and can be valued as such) [Hull, 2018].

more certainty of outcomes, not less. Finally, the investment attractiveness of normal margin businesses with very high up-front costs, such as electricity infrastructure, are particularly sensitive to risks.

With these basic terms (which we will continually refer back to) laid out, the next three sections of the paper spell-out the three very different perspectives on electricity governance in SSA.

# 3. Financial investment governance

This governance perspective encompasses the rules and institutions (or lack of) which directly influence the investment environment in SSA. It is observable, by applying Dixit and Pindyck's definition of investment (*sec.2.2*) to governance, that there is a period of uncertainty between the initial cost and the future rewards. To reduce risk therefore, 'good' investment governance will entail factors that protect the 'immediate cost' of an investment and then enable the delivery of the 'future rewards' proficiently and with certainty – consistent with the expectations of the investment when it was planned. Bad investment governance, concern factors that destroy or remove value from both the 'immediate cost' and the 'future rewards' of the investment. These will now be characterised as the ability to appropriate.

With SSA electricity infrastructure development, there are several observable structural governance factors that are perceived as being common in SSA by private investors, which can prevent the ability to appropriate, producing a compromised investment environment. These are now categorised below.

## *3.1 Uncertain property rights*

Central to understanding how uncertainty influences an investment in new electricity infrastructure in SSA is the concept of investment's physical illiquidity discussed earlier (*sec. 2.2*). With standard electricity infrastructure development in SSA, the investment's value will be tied to the location of the development. The certainty of ongoing ownership of the asset and its revenues is therefore crucial. Any negative uncertainty surrounding the support of property rights is therefore a fundamental structural governance issue that destabilises investment [Williamson, 1990].

The governments of SSA take significant pride in their national sovereignty of their territories and the assets that reside within them; but as this pride is often realised by the usurping of property rights when deemed expedient, this creates unintended negative uncertainty, reducing the attractiveness for foreign private investment. The past behaviour of the Mugabe regime in Zimbabwe, particularly over the ownership of land, represents a good example of such outcomes [Compagnon, 2011]; similarly, there are open political debates over whether such an approach should be repeated in South Africa.

### *3.2 Excessive planning costs due to a lack of standardisation*

In much of SSA, there is no standardisation of the tender process and/or paperwork for a privately financed electricity infrastructure project, particularly for unsolicited bids [CEPA 1, 2015]. Because of this governance issue, "*it takes projects in Africa on average seven years to advance through the project development cycle*" [CEPA 1, 2015:6, citing AFDB & Africa50] and the planning costs can be as high as 10% of the project value, in contrast to the OECD standard of under 1% [Castalia; 2014:21]. For example, in Kenya, a Power Purchase Agreement (PPA) is 1000 pages long, where an equivalent Indian off-take agreement for electricity would be expected to be only 20 pages [Collier, 2014:40].

It is challenging for an under resourced government that is already struggling to deliver all the services that are expected of it, to further facilitate such a specialist capability, but their failure to do so has unintended consequences. The costly commitment entailed in producing a comprehensive tender represents a significant 'sunken cost' for the sponsor, which is difficult to justify when there is no certainty of reimbursement. Delays and associated costs discourages investment interest from ever arising, particularly as tariff regulated electricity infrastructure is a relatively low margin business with very high up-front costs on top of this planning cost [Labordena et al, 2017]. The higher the fixed set up costs are as a percentage of the total value of the project, the more subdued investor interest will be [Bessis, 2015; Dixit & Pindyck, 1994]. It is to mitigate such issues that South Africa has created its IPP Office [16] (some argue, with great success) and the IFC has instigated its 'Scaling Solar' program[17] [IFC, 2016:30].

[16] https://www.ipp-projects.co.za/
[17] https://www.scalingsolar.org/

### *3.3 Reallocation of project ownership/control*

Past-unexpected reallocation of larger scale infrastructure projects to an unrelated party (usually between the planning and construction phases) have created huge indecision amongst investors as it creates the perception of policy uncertainty [Friebe et al, 2014]. This transfer again results in an instant loss of value of the discussed preparation costs up to that point, discussed in (*sec.3.2*), by an investor. This is slightly different risk to uncertain property rights, discussed in (*sec.3.1*), as reallocation of projects usually occurs because of excessive delays in the commencement of a projects construction – but as excessive delays are 'par of the course' in SSA, due to the many challenges that surround projects in the region, this is questionable in its legitimacy. Examples of such reallocations are the Grand Inga dam project in the DRC and the MphandaNkuwa dam project in Mozambique.

### *3.4 Equity dilution, ownership restrictions, and 'local content' procurement*

Conventions, both explicit and implicit, that convey a percentage of domestic (African) ownership are widespread for 'greenfield' infrastructure projects throughout SSA: where an extraterritorial privately owned project is expected/required to allocate a significant percentage of its ownership (equity) in that project to domestic interests (such policies are not unique to SSA). South Africa has its Black Empowerment legislation[18] and Mozambique has local equity ownership rules concerning Public Private Partnerships (PPPs) [19] of 5–20% of the equity in the project[20], as examples; but these arrangements often can be less transparent[21]. This can be a very constructive feature of governance, when done in ways that deliver value to a project, as it helps to allocate value to domestic interest and align both domestic and foreign stakeholder interests (which forms part of

[18] https://www.thedti.gov.za/economic_empowerment/bee.jsp

[19] Public Private Partnerships (PPPs): This is the standard type of investment vehicle that is utilised by SSA governments, to attract private sector investment for infrastructure development. The World Bank PPPIRC defines it as: "A long term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and the remuneration is linked to performance." (ppp.worldbank.org)

[20] Legislation: Law 115/2011, August 10 – Public-Private Partnerships (PPP), Business Concessions (BC) and Mega-Projects Law (MPL).

[21]https://www.transparency.org/

our ‘good governance’ objectives – sec 2.1) – but equally destructive, when it removes value.

The introduction of new stakeholders at the equity level

> *“Even from the development stage of a project, {potentially} introduces cleavages between partners. As a project expands to include more participants, it becomes more difficult to allocate the project's potential value in a way that all stakeholders see as fair. Greed generates an imbalance in the distribution of the project's costs and rewards—an imbalance that grows with the scale of the project, generating seeds of resentment along the way. The award-winning construction project analyst Edward W. Merrow claims that the inability to allocate costs and benefits fairly dooms most {projects} before they ever get started. However, even when the projects do proceed, those who believe they have been treated unfairly never let go of their opposition. Instead, they generate what he describes as project “turbulence” that often overwhelms even the most well intended project management”*
>
> [Sovacool & Cooper, 2013:45 – citing Merrow, 2011].

Lastly, in South Africa there are also local content rules that dictate a necessary level of local procurement to be included in a project, even if this is sub-standard to or more expensive than alternative overseas sourced materials10. In other SSA countries, as there is no applicable industry to support, this is a less pertinent issue except for how it can influence employment. The employment of local unsuitable staff may be encouraged over better qualified expatriate alternatives.

The worthy intention of all three practices is to enhance domestic ownership of important assets and/or increase domestic participation in the recipient country's economy; the unintended consequence of such directives is to create risk through the transfer of value, which then impedes the investor's ability to appropriate.

### *3.5 Exchange rate convertibility*

This dimension from the financial governance perspective concerns the inability to repatriate the initial cost and the rewards of an investment, into the original currency of the investor [Sovacool & Cooper, 2013:49]. In SSA, all currencies are termed ‘soft’ (excluding SA), meaning they are illiquid and not easily exchangeable in large value transactions. As discussed earlier, electricity infrastructure investment needs to be sourced from overseas (sec 2.2), but the investment's revenues are domestically produced. This creates a significant inability to repatriate the immediate cost of an investment back into the original currency of the overseas investor [Sovacool & Cooper, 2013:49]. This becomes a governance issue, when the illiquidity is compounded by exchange controls,

which prevents any repatriation of money from the country. For example, Mozambique introduced such restrictions in 2016, where unless the funds have been earned through export (domestically sold electricity does not qualify), they cannot be repatriated from the country11 [Bloomberg[22]]. The inability to repatriate funds by an investor is the ultimate barrier to appropriation and is an investment killer: as this removes both the 'future rewards' of an investment as well as destroying the 'initial value'. This risk is a factor that is often missed by the academic development literature [Gregory & Sovacool, 2019].

### *3.6 Monopoly control of electricity supply*

As the availability and affordability of electricity supply is widely regarded as a public good [Byrne & Munn, 2003], it is standard practice throughout SSA for the electricity utilities to be government owned and protected, with monopoly rights over grid supplied electricity [CEPA 1, 2015; UNCTAD, 2017]. This reality however requires that investors accept that their customer for any electricity commercially generated, will likely be a recipient country's utility. This is problematic, as these utilities do not have an investment grade credit rating, preventing them from being considered a credit worthy counterparty from the perspective of an investor [CEPA 1, 2015; Amars et al, 2017; Eberhard & Shkaratan, 2012; Eberhard et al, 2017; UNCTAD, 2017]. The unintended consequence of such monopoly control is again a disruption to investment: barely solvent monopoly utilities represent a significant investment risk.

A standard way around this is for the actual government to offer guarantees. For example, Kenya has partially done so with the Lake Turkana wind farm project, through guaranteeing/underwriting connectivity of the project to the country's electricity grid[23]; Tanzania has granted sovereign guarantees to the Songas project. However, SSA governments are often reluctant to give such guarantees (see sec 5.3) [CEPA 2, 2015; Amars 2017], and when they do, they can refute their obligations giving rise to a 'credit rating' issues as well, as also happened in Tanzania surrounding the Independent Power Tanzania Limited:

> *The dispute relates to a Claimant's alleged investment in Tanzania, by way of a loan acquired by its subsidiary, Standard Chartered Bank (Hong Kong) Limited*

[22] https://www.bloomberg.com/news/articles/2016-08-05/mozambique-sets-foreign-exchange-limits-standard-bank-says
[23] Aldwych International – the developer

*("SCB HK"), made to Independent Power Tanzania Limited ("IPTL") in order to finance a Power Plant in Tanzania located in Tegeta, approximately 25km north of Dar es Salaam.* [24]

### *3.7 Uncommercial tariffs*

Commercially unrealistic tariff regulation, which restricts the ability of an investor from capturing enough value to deliver a minimum suitable level of 'future rewards' from participation, is very common in SSA. The usual argument cited for the uncommercial, low levels of tariff is that it protects poor consumers against unaffordable and expensive electricity. The reality however is that low-income households are excluded from the electricity supply and will continue to be so if private investment doesn't increase; instead it is the successful political lobbying from wealthier consumers, particularly from business, that keep electricity prices low [CEPA 1, 2015; Eberhard & Shkaratan, 2012 – citing: World Bank and Fritz et al 2009].

Throughout SSA, electricity tariff rates are often below the actual cost of generation. So, when you consider there are also substantial losses of electricity in the transmission process, for example 25% in Tanzania [Amars et al, 2017]; and a significant failure of customers paying their bills [Amars et al, 2017; Kihwele, 2012; Eberhard & Shkaratan, 2012; Eberhard et al, 2017], this is a major risk for investment. It is plausible that the recent electricity generation cost reductions through renewable technologies, could be starting to improve this issue: in 2016, Zambia completed a solar tender at (US) 6.02c/kWh, the cheapest renewable tariff to that date in the region [IFC, 2016]. However, this creates a new kind of risk that will be discussed later, under Technology Governance (*sec.5.*).

### *3.8 Uncertain, protective Law & Order*

This final type of financial issue, both impacts on the physical infrastructure and the key staff that are required for the efficient operation of an investment asset.

Infrastructure can be damaged through acts of terrorism, vandalism or criminality; and key staff (especially expatriates) are increasingly under threat of unreasonable harassment by police and other 'officials', and in extreme circumstances kidnapping for ransom

[24] Case between Independent Power Tanzania ltd (ITPL) and Standard Chartered Bank https://www.italaw.com/sites/default/files/case-documents/italaw1184.pdf

[Sayed & Bruce, 1998]. In Mozambique for example, RENAMO (the current political opposition and former military foe during the country's civil war) have recently threatened to again resort to armed conflict[25]. Alternatively, the local police may supplement their unreliable incomes through harassment of foreign identifiable personal, by issuing false traffic offences.

In both Kenya and Zimbabwe (amongst others), significant political tensions exist between the government and opposition, which have manifested recently in major public disorder; where in Kenya transmission infrastructure is continually vandalised or has electricity is stolen from it, by marginalised populations; and key personnel are subject to kidnapping [Gumbe, 2016; Gregory & Sovacool, 2019]. In South Africa, as a legacy of the antiapartheid struggle, vandalism of electricity infrastructure is seen as a legitimate form of protest by the politically frustrated that are upset about continuing poor access to electricity; and large scale, organised theft of infrastructure is a common occurrence, particularly within the Gauteng municipality area [Egan & Wafer, 2004; Wenzel, 2016].

The unintended consequences of this is to make it difficult to operate an investment efficiently, as the assets maintenance costs will be very high, and it is difficult to recruit and preserve the skilled staff that are required to manage or maintain the asset [Labordena et al, 2017]. This then requires levels of compensation or contingencies, which weakens appropriation

# 4. Political governance

This governance perspective concerns the indirect investment consequences resulting from the way that SSA governments govern.

Statements delivered in an official capacity by various SSA government representatives at a recent African energy conference in South Africa[26], suggest that their governments appreciate that having access to the necessary finance to construct electricity infrastructure, is central to their ability to deliver an affordable and reliable electricity service to their populations. Further, those governments appear to accept that the only realistic source for this finance is through the successful engagement of international

[25] https://www.ibtimes.co.uk/negotiations-between-frelimo-renamo-suspended-mozambique-war-escalates-1573691
[26] The 2018, Africa Energy Indaba – February, Johannesburg, South Africa

private investors. Yet despite this declared recognition, we argue that there is still a failure by these governments to appreciate the un-intended consequences of how they govern. This is perhaps because the relevant 'political actors' are too focussed on their own direct political needs, rather than appreciating how their governance activities undermine the wider investment environment.

To help appreciate this incongruity, it is possible to unpack such a political governance failure into three causal components:

1) A power asymmetry – there is a power imbalance between the insiders (the political class) of the recipient country and the outsiders (the investors) without a reliable avenue of recourse if/when this asymmetry is abused [Booth, 2012; Levy, 2014];
2) Neo-patrimonialism – the governing elite's need to finance a political patronage system, to maintain control of the political structure that delivers benefits to those that administer it [Bratton & Van de Walle, 1994; Erdmann & Engel, 2006];
3) Policy confusion – uncertain and repeatedly changing policy priorities, driven by the contradictions of fulfilling the different needs of four separate constituencies: the political leadership, the leadership's principal supporters, the larger electorate (usually driven by an election) and multilateral stakeholders (such as aid donors or development banks). The resulting policy fluidity is then incompatible with the long-time horizons that the standard method of financing such infrastructure requires: known as Project Financing (*sec.4.2*).

From these three components, we can then extract two classes of investment risks: those that arise from *financial misappropriation* and those that arise from government *policy fluidity*.

## *4.1 The risk of misappropriation on a 'normal margin' business model*

The dominant explanation for the lack of foreign investment and the standard interpretation of governance failure in the SSA region, is a form of financial misappropriation through informal 'rent-seeking' [Krueger, 1974] facilitated by an abuse of asymmetric power [Amars et al, 2017; Booth, 2012; Collier, 2014; Darley, 2012; Kihwele et al, 2012; Levy, 2014]. Whilst accepting misappropriation is a burden on investment, we advocate in this paper that this is an incomplete explanation of the

problem. Many forms of 'rent-seeking' have been apparent in the recent and rapid economic transformations in China, India, Brazil, and South East Asia, yet these regions have still enjoyed rapid and constructive economic growth and sizable foreign direct investment (FDI) [Booth, 2012] – so financial misappropriation cannot be a definitive explanation for a reluctance to invest on its own. Instead, we argue, it is excessive and uncertain rent seeking on a normal margin business model, which destabilises the investment landscape. If the value of any required appropriation is foreseeable and is not excessive for the structure of business model that it is being applied to, an investment can still proceed and be successful. Such appropriation could even be legitimately formalised, as has occurred in Australia with their various government sponsored 'resource rent taxes'.[27]

When analysing foreign direct investment into electricity infrastructure in Africa, policy makers must recognise that when effective regulated tariffs exist, such investments becomes a normal margin business (*sec.2.2*): tariff regulation limits the ability to charge a 'rent' creating revenue. In fact, it is often difficult to achieve even 'normal' investment return from the ownership of electricity infrastructure in SSA (*sec.3.7*). Overseas investors recognise this lack of 'economic rents' in utility investments, unlike say the large 'rents' that are available from within the resource extraction investments – yet from within SSA governments, it is unclear whether this dynamic is appreciated. Evidence suggests that rent-seeking' practises often become disconnected from the existence of rents, particularly when pressures of the neo-patrimonialism system encourage rent-seeking behaviour from its 'political agents', regardless of whether rents exist to be captured. Further, *"privatisation and liberalisation might reduce rents, but increase rent-seeking behaviour or endeavour to acquire rent"*– as it both introduces commercial transparency, efficiency, and competition; whilst also creating more layers of bureaucracy and therefore possible 'rent-seekers' [Erdmann & Engel, 2006: 27].

Normal margins prevent electricity infrastructure investments from being sufficiently robust, when faced with any sizable uncertainty regarding misappropriation: as it is highly vulnerable to becoming, un-commercial when consistent illicit demands are placed upon it. As foreign investment in SSA is normally associated with the high 'rent' carrying

[27] https://www.ato.gov.au/Business/Petroleum-resource-rent-tax/; http://www.minerals.org.au/file_upload/files/reports/Deloitte_WA_Iron_Ore_Royalty_Analysis_7_Nov_2016.pdf.

business models associated with resource extraction, it is unclear how comprehensively SSA 'policy actors' appreciate this financing vulnerability (or care) that is applicable to electricity infrastructure projects [Gregory & Sovacool, 2019].

### *4.2 Policy fluidity risk*

Policy fluidity encompasses the issues of regulation and policy inconsistency, which disrupt the embedded factors that are necessary for the financing process during an asset's development and operation. These can impact either infrastructure cost inputs, caused by (but not limited to) issues such as technology application or procurement directives, creating investment risk; or infrastructure revenue outputs, caused by (but not limited to) such matters as controlled tariffs or taxes, which dilute investment return certainties. The reason government consistency is important, is due to the mechanics of the standard approach to financing electricity infrastructure that the private sector can use in SSA, which the finance industry labels 'Project Financing[28]'. Any unpredictable behaviour by government for the life of this financing process, normally 20 + years, discourages potential investors [Friebe, 2014].

Governments are inconsistent in their policy due to conflicting agendas and changing priorities, dictated by an attempt to satisfy the four different constituencies listed in this section's introduction under 'Policy Confusion'. Erdmann & Engel [2006] developed this type of uncertainty even further, by including an additional structural component that they have added to their neo-patrimonialism governance theory:

> "*Neo-patrimonialism is a mix of two types of domination. Elements of* {both} *patrimonial and legal-rational bureaucratic domination*[29], {that then} *penetrate each other*." *"The distinction between private and the public, at least formally, exists and is accepted, and public reference can be made to this distinction – it is a different matter whether this is observed or not"* [Erdmann & Engel, 2006: 18].

[28] Project financing – a project's cash flows ('future rewards') are pre-determined and then protected or guaranteed in some way, which allows it to be attributed a net present value or NPV. Finance is then advanced, against this NPV. The longer the guaranteed time-period, the greater is the value that is available to act as 'surety'. Such a process requires both the reliability and protection of the required cash flows, which demands both cost and revenue certainties to exist [Yescombe, 2002].

[29] A pillar of Max Weber's tripartite classification of authority – whereby decisions are reached through a process of legal rationality, legal legitimacy, and bureaucracy.

Policy risk arises, as it is unclear whether rules will be followed, or ignored – and ironically, the increase in transparency and modernisation of bureaucracies can increase this confusion.

These policy inconsistencies can often be the unintended consequences of 'international direction'. For example: a reforming government attempts to behave in a manner expected by multilateral stakeholders (such as the World Bank), but then such an approach brings it into conflict with the needs of the incumbent political system – which then pushes back, causing a reverse or further amendment of the policy. Alternatively, a government attempts to implement the unsuitable advice of 'outside experts', which is not compatible with the country's capability and knowledge skillsets. This occurred with the advent of the CDM, where African governments were persuaded to believe that their countries would be huge beneficiaries of the CDM, resulting with many making significant reorganisations internally to support it – yet when the CDM commenced; it in fact had little impact [Kreibich et al, 2016; Byigero et al, 2010].

It is possible that a policy misdirection is about to occur again, surrounding nuclear energy. Companies associated with the Russian nuclear industry, are encouraging African governments to adopt nuclear energy in their electricity policy mix (as witnessed at a recent African energy conference[30]). This is likely to have a substantial negative spill-over effects on wider investment if pursued, because of an alternative highly negative narrative held by unrelated potential investors on the subject – nuclear energy introduces a new set of risks, related to safety, long-term commerciality, and issues of disposing of spent fuel.

# 5. Technical system governance

Technical system governance in this paper, is a 'systems' perspective that encapsulates the governance issues that arise from the 'large technical system' that surrounds the process of electricity services provision in a country [Hughes, 1983]: which in this paper we refer to as the 'electricity delivery regime'. Such a system includes the various technology assets involved in the supply of electricity services: the generation assets, the electricity transmission and transformer assets, and the distribution technology

[30] The 2018, Africa Energy Indaba – February, Johannesburg, South Africa.

that delivers the electricity service to the household. Any consumer technology, that allows the households to use the electricity once it is available [Ibid]: such as lights, washing machines, televisions, etc. Further, it also comprises other less obvious technologies, such as the actual electrical wiring of the house: does it exist, how easy is it to install, and is it safe? Beyond the technology properties, it captures all the various levels of institutions that are denoted within the production, delivery, and consumption of the electricity: extending from the levels of government, through to the actual household. This includes the utility, any relevant regulators, independent but related equipment suppliers, independent power producers (IPPs), as well as any other applicable actors and institutions [Ibid].

This governance perspective is not applying a specific systems theory, we are instead using the term 'technical system' as a means of defining our spatial and temporal limitations of study: what is in and out; and which actors (stakeholders) to include. The predominant type of electricity system is a top down network 'hub & spoke' system [UNCTAD, 2017], which is the standard model used in the OECD for delivering electricity. This *standard model* in SSA, is government controlled and surrounds the utilisation of a series of large-scale electricity generating assets, with supporting transmission and distribution structures. However, these types of systems are both 'path dependent' [David, 1994; Nelson & Winter, 1982] and contain systemic risks in both their development and operation, wherever they may exist.

### *5.1 The universal systemic risks of technical systems*

An electricity delivery regime as a technical system, is in effect an innovation system. To function well therefore, it requires an efficient sharing of technology and knowledge between all the system's actors summarised above [Freeman, 1995; Lundvall, 1985; 1992]. The system's functionality also requires that all these actors have shared perspectives, shared ambitions, compatible skills, and universal technology and organisational standards within the system – both at an institutional and individual level [Ibid]. On the last point, as an electricity delivery regime this would include factors, such as the electricity system's standard voltage capacity, or the standard current used for the electricity's transmission ('AC' or 'DC').

Consequentially, to facilitate the above, the system requires both a good governance structure between the various stakeholders of that system (see this chapter, sec.2.1); and

an adequate level of suitable dynamic capability (see this chapter, sec.5.2.3) [Teece et al, 1997] within the relevant country's political-economic-social framework that it is located within (and by inference, within the system's institutions) [Freeman, 1995, Lundvall, 1992]. It also has to be flexible enough, to continue to evolve, reform, operate and apply the most appropriate technologies and organisational arrangements (commonly known as best practice) to maintain the efficiency of the system.

Such systems are also full of co-dependencies [Teece, 1986], where inefficiencies in one part of the system impact some or all the other parts of the system. In this paper's context: the generation, transmission, and distribution parts of the system, rely on each other to achieve their own efficient functionality. A failure in one, equally disrupts the other two constituents simultaneously.

Technical systems are likely to be inefficient if the system's governance has a predisposition to managing up, towards the perceived interests the dominant institutions within the system and those that control them; rather than downwards, towards those that the system is meant to serve: the end users (customers). They can also be locked into technology and organisational path dependencies, which makes change for improvement (innovation and its diffusion) difficult to achieve [David, 1994; Nelson & Winter, 1982]. Capabilities, both at an individual level [Sen, 1999], and an institutional level [Abramovitz, 1986; Bell & Pavitt, 1993; Nelson & Winter, 1982], require a certain level of penetration of relevant skill and knowledge to actually allow the system to function efficiently, and a certain level of continual application to keep them effective, functional and cumulative [Nelson & Winter, 1982; Scott-Kemmis & Bell, 2010].

Finally, the reliance of the system on a suitable level of dynamic capabilities, also creates another systemic risk. Many of those capabilities 'walk out of the door every night and go home', having the potential never to return. So, an electricity delivery regime can have at one point in time, a suitable level of capabilities – but at a later point in history, those capabilities may have retired or left the country. This has happened with the South African electricity delivery regime – which once had the capacity to build large generation assets but appears to not have that capability any longer (see chapter 6, sec.5.2.2).

## *5.2 Why the 'standard model' is unattractive to investors*

As a proven electricity delivery model, the standard model has served OECD countries well. However, in the SSA context, where significantly more than half of the region's population lives in rural areas and derive their livelihoods from subsistence agriculture, it is an unsuitable structure for attracting private investment support. This is because in SSA, the model is constrained by three systemic impediments:

1) The inability of the majority of African households to afford both the cost of electricity connectivity, particularly in rural areas; and then to use the electricity once it is available – undermining the commercial proposition.
2) A failure by the centralised monopoly utilities to manage and operate such a model efficiently and successfully in the region, where they lack the necessary dynamic capabilities described by Teece et al [1997] and governance structures – make the utility an unattractive investment partner, and the electricity system an unattractive investment destination..
3) A shortfall in the required political capital and support from the relevant political actors, to permit any necessary reform and system evolution – to ensure that this electricity delivery regime can maximise its potential efficiency and revenues.

These hurdles do not necessarily mean that alternative models of electricity delivery cannot prosper, but it does mean that whilst these factors persist, this kind of electricity delivery regime will remain sub-optimal. We now categorise how aspects of technical governance undermines investment is SSA electricity infrastructure.

### 5.2.1 The financing risks of technology transitional change

As if these three impediments in SSA were not enough for potential private investors to contend with, a destructive 'perfect storm' has recently arrived. These three traditional challenges are now being compounded by a fourth: the global transition in what type of electricity service technology is best to use – the traditional one, utilising fossil fuels; or the challenger, that utilises distributive renewable technologies [Ackermann, 2001; Lammers & Diestelmeier, 2017]. From the perspective of a private investor, fossil fuel technologies are likely to become uncompetitive and redundant, a 'stranded asset' problem [Ansar et al, 2013]; but the replacement distributive renewable technologies are still perceived as immature, and not yet commercially delineated [Lammers & Diestelmeier, 2017]. Investors prefer to invest in proven processes, which utilise familiar

technologies with a competitive and predicable cost structure [Bessis, 2015] – this technology realignment, removes these certainties.

Further, the current continuous improvement in renewable technology tariffs is also encouraging commitment delays surrounding new electricity infrastructure, from some of the region's governments, as they anticipate further reductions in tariff pricing; and fostering unrealistic tariff expectation from specific SSA governments. Apparently, Nigerian officials expect the recent low tariff struck in Zambia (US6.02c/kWh) to be a pricing benchmark for their own electricity projects. Such an expectation ignores the substantial difference in each country's perceived risk profiles to investors (their relative attractiveness as an investment destination) and specific factors such as the availability of soft loans that would not be available to Nigeria, that supported such a low tariff[31].

As most SSA governments remain committed from a governance perspective to a centrally controlled monopoly as its electricity delivery regime [Amars et al, 2017; CEPA 1, 2015; Eberhard & Shkaratan, 2012; Eberhard et al, 2017; UNCTAD, 2017], the impact of these systemic factors need appreciated in this context.

### 5.2.2 Unaffordable electricity Services

The inability of SSA households to afford electricity services is often offered as the principal reason for the existence of electricity poverty in the region [Williams N.J. et al, 2015; World Bank, 2010; Eberhard & Shkaratan, 2012; Gentzoglanis, 2013; CEPA 1, 2015]. This is not just about paying for connectivity or delivering electricity to the front door of a household, but also includes the costs associated with being able to then use it, such as the cost of electrical appliances or safely 'wiring' the recipient's home [Sen, 1999; Cook, 2011]. Although these are not governance issues in themselves how to respond to their realities most definitely are; and how to successfully overcome these realities, we argue, should be a central governance priority.

The network 'hub & spoke' system is somewhat suitable for electricity delivery in the region's principal urban areas, however its commerciality becomes unrealistic when it is deployed into rural areas, where the majority of SSA's population lives and electricity poverty is most extreme. Extending the grid is both very expensive to do and then properly maintain. In Kenya for instance, according to Parshall et al. [2009], it costs

[31] Comments received from several industry professionals, attending a recent conference in Johannesburg.

US$1900 to connect the more remote households (and this is likely to have increased), with no account for the cost of ongoing maintenance of the network or the further burdens of making it useable by households [Williams NJ et al, 2015:52]. This cost is beyond the resources of all, but a few select households. Such grid extensions are therefore difficult to justify commercially, a prerequisite for private investment, despite the obvious 'positive externality benefits' [Pigou, 1932] offered by such connectivity [Cook, 2011; Collier, 2014]. For the grid to be extended a subsidy is required from an unrelated source: which is usually the government through a form of rural electrification agency or program [UNCTAD, 2017].

The unintended consequences of persisting with this delivery system, for potential investors, is that it removes any likelihood of their participation in the distribution aspect of the infrastructure regime, as they are even more disadvantaged than the government as owner of such assets, as they are unable to capture any of the externality value [Collier, 2014]. For an IPP, it weakens the utility's credit worthiness in their capacity as the 'offtake' customer, as ongoing subsidies from fiscally weak governments are uncertain – this is, unless an unrelated to the customer (either the utility or end using consumer) financing structure can be identified. The extent of this challenge is probably best illustrated by the experiences of the RSA's 'rapid electrification program', during the transition period from apartheid.

> "*Prior to 1990, less than a third of the population {of the RSA} had access to electricity. By the end of the decade that proportion had doubled*" [Bekker et al, 2008:3125].

By the mid-1990s, it had become evident to Eskom that further electrification through grid extension was not a commercial proposition and could only be carried out through deficit financing off its own balance sheet and through cross subsidisation from other industrial and wealthy municipality users. This, however, is not an option for other SSA countries, as they do not have such endowments – and some of Eskom's current financial vulnerability problems can be argued to have started with this balance sheet subsidisation. The SA government finally took over the responsibility for financing the program from the early 2000s, through a national electrification fund [Bekker et al, 2008] – but still electricity access is not universal, almost 20 years on.

Distributive renewable technology can sidestep the grid extension issues just highlighted: as these technologies no longer require the utility grid network for delivery, as they can be operated on a smaller scale (reduced cost) and independently of the

electricity grid. Despite this however, affordability is still an issue as such technology options still require a large financial outlay relative to rural household incomes. More importantly, as such technologies are still making significant advances in both cost and efficiency – it is sensible for investors/developers of larger capacity infrastructure, to delay investing in this technology, until it has matured and become stable, from an electricity unit (kWh) cost basis.

### 5.2.3 Operational inadequacies

To effectively operate this type of electricity delivery regime requires a utility to have a minimal level of both technological skill and tacit knowledge (capabilities) within its management structure [Bell & Pavitt, 1993], as well as a need for enough working capital. Without adequate levels of capability, the likelihood that a utility will recover its cost of delivering electricity when it sells it becomes too uncertain due to both technical and non-technical losses. Technical losses entail a significant loss of electricity in the transmission, through a lack of maintenance of the transmission system – as high as 25% in Tanzania for example [Amars et al, 2017]; or an inability to operate effectively a demand and supply *load* management, within the network [UNCTAD, 2017]. Non-technical losses entail a significant risk that customers will not pay for the electricity they use [Eberhard & Shkaratan, 2012]: either by not paying their bills, or stealing electricity directly from the grid, or bypassing their electricity meter [Bekker et al, 2008].

The issue of uncommercial tariffs (discussed in sect. 3.7) then compounds this looming spectre of technical and non-technical losses. A combination of these factors will then push the utility towards insolvency, which can only avert by ongoing government subsidies - which are never enough. This stressed condition then results in further poor maintenance of the network, and little carriage of spare parts, which results in the network wearing out [Gregory & Sovacool, 2019a]. Such a monopoly utility cannot be regarded as both a credit worthy and proficient commercial partner for a private investor.

Transmission and generation electricity infrastructure are co-dependent and reliable on each other for their commerciality, as value cannot be appropriated from one part of the infrastructure chain, without the other parts. The construction of the Lake Turkana wind farm in Kenya was completed in mid-2017, but the required transmission lines connectivity was delayed into the second half of 2018, as the utility KETRACO has been

unable to keep to its construction schedule[32]. This reliability on third parties for connectivity is important in SSA, as it can be difficult to receive compensation for any failures elsewhere in the infrastructure jigsaw.

### 5.2.4 Utility insolvency and subsidy dependence

When utilities only stay solvent through government subsidies from general revenues (and indirectly, aid), this puts financial pressure on each governments balance sheet: particularly as the incremental cost of the new supply, has been much higher than the original existing supply [Eberhard & Shkaratan, 2012], markedly when mobile diesel generators are used. An aggressive pursuit of such a strategy has a danger of forcing a financially stretched national government into financial default [Bekker et al, 2008], which introduces a completely new set of risks. This clearly dampens a government's willingness to underwrite a private investor's commercial risk. It is too early to judge how renewable technology will alleviate this issue. They also must justify their financial support of a commercial enterprise over alternative political priorities that are more electorally visible.

### 5.2.5 Technical system patrimonialism

Lastly, when a government is ‘closed minded’ to the electricity delivery regime's efficiency. This can either due to hostility for a new technology application, such as the application of distributive renewable technology over existing fossil fuel technology – as it potentially weakens its control over that delivery regime. Alternatively, the current electricity regime is used to reward the political incumbent's supporters and is integral to their neo-patrimonialism political structure: preventing investment, as it creates an unreliable investment partner.

# 6. Discussion: synthesising governance perspectives

If SSA governments genuinely believe that the most suitable policy for increasing access to electricity for their populations involves attracting private investment – then they must also be prepared to amend their current governance structures, to nullify those unintended consequences that make such investment unattractive. Further, these

[32] Aldwych International – the developer

governments must also recognise that unlike natural resource extraction industries, a correctly regulated electricity infrastructure is a ‘normal’ margin business, that can quickly become uncommercial, and therefore unattractive as a private investment proposition, if costs increase or revenues decline.

Similarly, the development community must also appreciate that the challenge of delivering electricity access within SSA is essentially an issue of finance. Finance is therefore an enabling variable and a ‘gatekeeper’ to the resolution of accessibility – electricity connectivity requires a supporting infrastructure for its delivery, which will only exist if it can be paid for (and this includes smaller scale solutions). However, the ability to attract private finance is a dependent variable that relies on its own enabling variables, which include those that surround the process of governance. If the dominant development policy narrative for delivering electricity access to the region is to be successfully constructed around private investment, as the multilateral development community advocates, their approach to governance design also needs to be reprioritised, to include the reduction of investment risk.

Ultimately, each of the three governance perspectives – investment, political economy, and systems – has different foci, and as such each misses aspects that the other perspectives offer. However, a synthesis of all three yields a more holistic governance framework, which points the way towards what a supportive environment for electricity investment might look like. Drawing from Dixit & Pindyck, [1994:3] (*sec.2.2*) – an illiquid investment displays three important characteristics.

- Firstly, the investment will be irreversible, once an investment has commenced, it cannot simply be unwound without a significant loss of value. In this paper’s context, construction must be completed, and the commissioning of the asset delivered as envisaged during the planning of the infrastructure, before any value can be realised.
- Secondly, there will be uncertainty over future value of the investment: unanticipated things can happen to an electricity infrastructure development project that could negatively affect the project's deliverables before an assets operation commences.
- Thirdly, an investor controls their decision where and when to physically commit their financing and proceed with an investment [Dixit & Pindyck, 1994].

Using these three dynamics, it is possible to create three effective 'good governance' filters to determine how to evaluate a supportive governance structure for investment:

(i) Will a country's investment structure allow the reimbursement of the value of the initial investment (the initial cost), in the future?

(ii) Will a country's political structure undermine the appropriation of the anticipated returns of an investment (the rewards); or meaningfully delay them?

(iii) Will a country's electricity delivery regime put an investment at a disadvantage, when compared to alternative comparable technological investment opportunities in alternative countries? (As every investment decision to proceed for a private investor, is a relative decision).

These filters affirm the salience of Financial Investment Governance: the private sector investor perspective, which embodies the ability to efficiently create and repatriate investment value. They affirm the salience of Political Governance: the political economy perspective, concerning the application of one-sided asymmetric power, and how this can permit the misappropriation of uncertain and excessive value. They affirm the salience of Technical System Governance: the electricity delivery regime perspective, where the system's inability to efficiently innovate and diffuse electricity technology prevents a necessary appropriation of value that is necessary to make the application of the technology attractive.

When applied to SSA investment in new electricity infrastructure development, our synthesized approach to governance suggest 15 structural factors (some of which are unique to the region) that require appreciation by 'policy actors'. These factors negatively influence the ability of the investor to generate and repatriate revenue (which represents both the initial value and the rewards of the investment). Identified structural factors synthesisable from across our three unique governance perspectives include:

1. **Insufficient local banking capabilities**: In most SSA countries, the domestic banking systems are unable to finance any significant value of electricity infrastructure projects, even at a household level.
2. **Exchange rate convertibility**: the inability to repatriate the principal investment and the investment's returns, into the foreign investor's original currency – usually attributable to either exchange controls or insufficient African currency liquidity.

3. **Uncommercial tariff regulation**: electricity tariffs are not permitted to be commercially reflective for the cost of the investment.
4. **Inadequate law and order structures**: In many SSA countries, the institutions of legal enforcement do not prevent theft of various forms of value from an investment, as there is no effective recourse, or they represent the actual perpetrators.
5. **Uncertain security of the physical asset**: the probability that the value of the investment will be diminished or destroyed by an independent third party's action, such as theft, vandalism, or terrorism.
6. **Uncertain revenue security of the asset**: the probability that an unrelated third party will unexpectedly misappropriate the anticipated revenues (or a percentage of) from the investment.
7. **Unearned equity dilution**: the requirement to allocate significant percentage of ownership (equity) of an investment, in return for nothing other than a permission to proceed.
8. **Rent-seeking**: the attempt to appropriate excess value or 'rent' from an investment that does not exist, by non-related beneficiaries of the investment.
9. **Corruption by officials**: the abuse of a power asymmetry, in return for non-obligatory financial gain.
10. **Patrimonialism**: the transference of value to an unrelated party (an insider) to support a political patronage system.
11. **Reallocation of the ownership of a project**: a project's ownership can be unexpectedly removed and reallocated to an unrelated party (usually between the planning and construction phases). This means an instant loss on all preparation costs up to that point by an investor (which are already excessively high) [Castalia, 2014].
12. **Path dependency and regime resistance**: the government or the monopolist utility are locked into a technology paradigm, which makes them hostile to change. For example, the ongoing preference to use coal as an electricity generating technology (often due to personal conflicting priorities).
13. **Insufficient working capital**: there is insufficient working capital available within the utility, to support, operate and maintain the technological system at efficient levels.
14. **Deficient technological tacit knowledge and skills**: the successful diffusion of different electricity technologies are impeded, due to a shortfall in both household

[Sen, 1999] and institutional technological capabilities [Abramovitz, 1986; Bell & Pavitt, 1993].

15. **A lack of complementary assets**: the supplementary assets or capabilities that are required to allow the primary asset to operate optimally are not available [Teece, 1986] such as an efficient and working electricity grid.

All 15 factors are significant or at least meaningful, and they offer 'policy actors' and researchers a novel checklist when attempting to determine the particular risks facing any given SSA country's infrastructure development.

# 7. Conclusion

We recognise that whilst we must resist the dangers of overly homogenizing each of the three governance perspectives, many of the themes or factors may exist in most SSA countries: national context, resources, business patterns, industry strategies, levels of affordability and types of electricity infrastructure (to name a few) – do have regional applicability. When applied to each country however, we accept that they will still yield different shapes, and unfold differently (and indeed, even sub-nationally).

Thus, it is critical to treat SSA countries as heterogeneous, and to design specific policies attuned to this complexity, accordingly. That said, there is still value to the meta-theoretical governance principles underlying the three perspectives. There is a 'top down' challenge: why internationally sourced private investment is deterred from investing in SSA electricity infrastructure, as well as a 'bottom up' one for why individual governments might or might not constrain such investment. It is also reasonable to apply homogeneity to the international investment community's approach to this challenge, as they have a commonality of purpose in the way they approach investment (sec 2.2): they are all seeking an investment return from an initial commitment of investment value.

The implication that arises is a mix of bottom up heterogeneous factors need balanced with the commonality of barriers (and perceptions from private sector finance) to create more attuned policy that arbitrates or mediates local factors with transnational expectations. To minimise these unintended consequences, SSA governments need to redesign their governance structures to deliver a minimisation of negative uncertainty to the value of the immediate cost of an electricity infrastructure investment, and a maximisation of certainty towards the future returns of that investment. This will require

a government to deliver both cost and policy certainty to investors – as excessive change in either of these, increase costs, which then retards private investment. Finally, governments should discard (or at least adapt), the ‘network, hub and spoke’ model, and relinquish their utility's monopoly control. Electricity service delivery needs to be decentralised, to permit flexibility in the adoption of new technologies and electricity delivery solutions, to facilitate electricity access in poorer rural areas, where all possible costs need to be stripped out of the process, and maximum flexibility is essential.

The ambition of this paper has been to realign our understanding of the impact of governance, when it is applied to the private financing of electricity infrastructure development in SSA. Perhaps when this occurs in practice – if policy actors, financial institutions, and development practitioners calibrate their investment, political, and technological systems of governance accordingly – SSA can transform itself from a perpetual laggard to a promising leader for electric utility investment and reform.

# Chapter 5:

# *Governance, scale, and scope: reviewing six South African electricity generation infrastructure megaprojects*


## Abstract

Following a U-turn in government policy in 2005, The Republic of South Africa embarked on simultaneously building three electricity generation megaprojects: two-4,800MW coal fired power stations, Medupi and Kusile, to generate base load electricity; and a hydro pump-storage facility, Ingula, a 1,332MW peaking power facility. All three projects have been problematic to build and have facilitated the bankrupting of the national electricity utility Eskom, whose survival is now in the hands of the South African government, its sole shareholder. This paper reviews six case studies to understand what happened, which includes three counterfactual projects. The fieldwork utilised a governance lens and involved original data collection via 32 interviews with experts deeply involved with at least one of the six projects. This included past and present senior Eskom management and other well-informed parties with alternative perspectives. The study found that aspects of governance, scale and scope were significant, to such projects success.

# 1. Introduction

From an economic growth perspective, access to reliable and affordable electricity in sub-Saharan Africa (SSA) is a major developmental obstacle [AfDB, 2018; Blimpo & Cosgrove-Davies, 2019; Briceño-Garmendia et al, 2008; Gregory & Sovacool, 2019a; Halff et al, 2014; Moyo, 2013] and a major challenge for a region whose population is projected by the UN to double by 2050 [UN News]. If SSA governments intend to persevere with a top down network 'hub & spoke' system[33] or 'standard model', to expand access to electricity services - it is crucial for these governments (and other potential financiers of such expansionary infrastructure development) to appreciate any contextual challenges that may hinder the extension of this standard model, before attempting to expand their own systems further. Such knowledge is particularly pertinent if the private sector is to finance such infrastructure development, as the dominant multilateral development narrative is demanding [Collier, 2014; Eberhard 2015, Gregory & Sovacool, 2019b].

Current evidence from South Africa (RSA), suggests that the most problematic component of this model to develop, is the electricity generation component: particularly when it involves sizable individual assets, which enter the scale and scope of a megaproject. Due to the urgency to expand electricity access across the African region to respond to expected population growth, this paper will analyse the development challenges for developing large-scale electricity generation assets, using case studies from the RSA – which is the only country in the SSA region to offer a depth of megaprojects, for this type of study.

Six megaprojects were analysed, using data collected over a six-month period from thirty-two interviews with well-informed experts with varying perspectives. Three of the projects chosen, were problematic; and the remaining three were successful, to act as a counterfactual. Successful project delivery is defined in this paper, as the adherence to the anticipated project deliverables, as foreseen during the project's planning process – was both the budget and schedule adhered to; and once completed, will it generate electricity for the planned cost and output? The interview questions asked were mostly deductive (see *sec.3.4*), to confirm the applicability of three principal governance

[33] The utilisation of a series of large-scale electricity generating assets, with supporting transmission and distribution structures.

narratives identified in the literature by Sanderson [2012] for explaining megaproject failure. However, and perhaps more importantly, the data was also able to deliver a very valuable understanding of the impact of scale and scope on megaproject development success as well. So despite the original ambition of this paper to just apply a governance analysis to explain such megaproject failure, it has instead expanded its analysis to now embrace how project governance, scale and scope has affected such infrastructure developments – using its original research fieldwork as a scaffold to permit such analysis.

# 2. Literature review

The academic project management literature is becoming rich with analysis and explanations surrounding megaproject failure (and success): Brady & Davies, 2014; Brookes & Locatelli, 2015; Davies et al, 2009; Flyvbjerg, 2017, 2014, 2009, 2005; Kardes et al, 2013; Locatelli et al, 2017; Maylor et al, 2008; Sanderson, 2012; Van de Graaf & Sovacool, 2014; Williams & Samset, 2010 to name some of the more prominent papers. This literature however has a bias towards an OECD[34] context; and concerning the RSA, it is very thin and arguably empirically inadequate[35]. Fortunately, this paper's supporting fieldwork (discussed in *sec. 4 & 5*), suggests many of the factors and characteristics attributable to megaproject failure identifiable in the OECD orientated academic literature, still have relevance and validity to such projects in the RSA. This is particularly true for issues surrounding complexity: where more complexity results in more problems; and vice versa, less complexity delivers less problems.

## *2.1 Defining a megaproject in South Africa*

Megaprojects can mean different things to different people, depending on the theoretical perspective one wishes to apply [Sovacool & Cooper, 2013]. Even if one just applies an economic definition, the dominant academic approach, there is still variance. Most scholars, such as Bent Flyvbjerg, define megaprojects by scale and cost –

> "*Megaprojects are large-scale, complex ventures that typically cost a billion dollars or more, take many years to develop and build, involve multiple public and*

[34] OECD – Organisation for Economic Cooperation and Development

[35] Plausibly explained by the limited frequency of megaproject developments in the region, causing academic resources to focus elsewhere.

> *private stakeholders, are transformational, and impact millions of people*" [Flyvbjerg, 2017b:3].

Others argue however, such as Allan Warrack [1993, citing Warrack, 1985], it is the nature of the stakeholder context and complexity that should be the defining feature – which would then include some projects significantly less than US$ 1 billion in value.

As already noted in the introduction of this section, most of the project management academic literature has an OECD context bias. As this paper's analysis is focusing on the developmental context of Africa, it chooses to be less value prescriptive and instead draws heavily on the development economist Albert Hirschman's empirical work summarised in 'Development Projects Observed' [Hirschman, 1967]. His observations and analysis of the Nigerian Railway Corporation appears to still have validity to a South African context – as many of the themes he identified, are still consistent with the recent research findings summarised in section five of this paper. Hirschman suggests socio-political structures have a significant baring in Africa on what defines a megaproject[36] development, as well as access to the relevant capabilities [Ibid: 134]. This paper will therefore favour Hirschman and Warrack's definition, where stakeholder complexity is the primary qualifying feature for defining a megaproject in South Africa.

## *2.2 Conceptualising megaproject complexity*

Megaprojects are organisational systems of interacting stakeholders, components, and sub-systems, designed to deliver a common developmental purpose [Brady & Davies, 2014; Maylor et al, 2008; Williams & Samset, 2010]. Complexity in the context of this paper, specifically applies to the interactions between these various stakeholders, components, and/or sub-systems. Further, this complex system has path dependency inbuilt, defined by its initial conditions [Maylor et al, 2008]. Any megaproject *"takes place in a historical context, and its starting conditions (e.g. the state of existing relationships between stakeholders, the trust between project team members) cannot be calibrated precisely to be able to make reliable predictions* [Maylor et al, 2008:s16]. This paper will return to these important facts on multiple occasions, whilst reviewing its case study's research data.

[36] Megaprojects – Hirschman did not use the term 'Megaprojects', as it had not become an accepted term in 1967.

All megaprojects share characteristics due to their scale and their uniqueness: all of which create complexity, making megaprojects problematic to deliver.

- Their ownership and agency arrangements are usually separated: as they are temporary activities with a requirement for unfamiliar project capabilities to the ultimate owner/sponsor, which makes it difficult for that owner/sponsor to manage and control both costs and progress.
- They have long planning and construction horizons: which increases performance risk.
- They require atypical design and technology usage: rendering standardisation and modulation difficult to achieve.
- Their planning, organisation and execution are typically multi-actor processes with non-aligned agendas and insufficient commercial familiarity with each other: preventing reciprocal knowledge sharing and efficiency, as such interactions require trust and familiarity developed through a shared history.
- They have many separate but related sub-routines with complex interfaces: many of which are tightly coupled. This usually makes each module's performance mutually dependent and subject to non-linear error growth (see *sec.2.2.2)*.
- Finally, all mega projects have legacy issues, and are economically and socially transformative – redistributing social, economic, and political power. This renders them fundamentally as political decision, even when they are in the domain of the private sector.

  [Synthesised from: Brookes & Locatelli, 2015; Brady & Davies, 2014; Brady et al, 2012; Davies et al, 2009; Flyvbjerg, 2017b; Kardes et al., 2013; Maylor et al, 2008; Sanderson, 2012; Van de Graaf & Sovacool, 2014; Williams & Samset, 2010].

It is commonly the inability to manage the complexity of megaprojects, which is at the core of megaproject failure. However, complexity in the context of megaprojects is ambiguous, subjective, and often ill-defined [Brady & Davies, 2014 – citing William, 1999 and Geraldi, 2008]. It is therefore necessary to quickly identify and describe the two principle broad types of complexity that can contribute to megaproject's failures (as synthesised from the recent project management literature) – which will also then be referred to during the analysis of the case studies. Complexity is not the primary focus of this paper, so it will not drill down into this issue of complexity any further than is

necessary – this section is just providing a platform, to analyse the empirical case study data in *sec.4.0*.

### 2.2.1 Structural complexity

This primary catchall category consists of the types of complexity that arise from the projects initial design and organisation. This includes the arrangement and connectivity of components and sub-systems; the integration and engagement of both contractors and sub-contractors into the system; and the incorporation and application of technology. It also includes the governance arrangements between stakeholders, the project's various agents, and the project's remaining eco-system [Brady & Davies, 2014; Brady et al, 2012; Davies et al, 2009; Maylor et al, 2008; Van de Graaf & Sovacool, 2014; Williams & Samset, 2010].

### 2.2.2 Dynamic complexity

This alternative catchall category, consists of the types of complexity that arise from changes that occur after a project has commenced (and therefore not planned for), and are often described as issues of project 'turbulence' [Ibid] – incorporating all the inclusions listed in *sec.2.2.1*. The most troubling aspect of dynamic complexity is the impact of non-linear error growth – where a change earlier in a project's lifecycle, increases its impact disproportionately, as the project progresses: due to the interdependence of the sub-routines and its complex interfaces. All structural complexity issues have the potential to morph into dynamic issues, often as un-intended consequences of other changes. Building from the issues described earlier surrounding path dependency, overlaid by non-linear error growth – issues of dynamic complexity have the greatest potential to be most damaging to a megaproject success.

## 3. Methods

This section outlines the conceptual approach used in this paper. It also explains the three categories of governance used for analysis and clarifies this paper's empirical fieldwork.

## *3.1 Conceptual approach*

This paper applies three governance explanations identified by Sanderson [2012] to explain megaproject failure, to six electricity generation projects in the RSA. Sanderson originally identified these three explanations in the literature, through a form of snowball sampling[37]. In this paper, Sanderson's three categories have been slightly re-positioned, to reflect more recent evidence (including this paper's fieldwork) and re-titled. These are: a) **Forecast inadequacies**, where the planning process uses inaccurate and overly optimistic assumptions [Flyvbjerg, 2005, 2009, 2014, 2017b; Flyvbjerg et al, 2002, 2003; Sanderson, 2012; Wachs, 1989, 1990]. b) **Deficient complexity management**, to reduce the problems that arise out of aspects of project complexity [Brady & Davies, 2014; Kardes et al., 2013; Maylor et al, 2008; Miller & Lessard, 2002; Millar & Hobbs, 2009; Sanderson, 2012; Williams & Samset, 2010]. c) **Rivalrous project goals**, where different stakeholders and/or agents desire competing outcomes from the megaproject [Alderman et al., 2005; Atkinson et al, 2006; Locatelli et al, 2017; Rafey & Sovacool, 2011; Sanderson, 2012; Van de Graaf & Sovacool, 2014].

The six case studies used are **Medupi, Kusile, Ingula, Sere, Avon and Dedisa**. The first four are owned and managed by Eskom, the RSA's national electricity utility, and the remaining two are independently owned peaking power stations: which sell their electricity to the Eskom owned electricity grid. As Medupi and Kusile, which are the two largest projects, are not yet complete, due to substantial delays: this paper's analysis will only focus on cost and schedule performance, and not the post commissioning operating performance.

## *3.2 Defining and categorising three types of megaproject governance*

A governance lens was applied, as governance embodies socially constructed behaviours and institutions that can be modified and *supposedly* improved [Booth, 2012; Florini & Sovacool, 2009; Gregory & Sovacool, 2019b; Levy, 2014] – in contrast to say capabilities, which are more difficult to transform quickly [Abramovitz, 1986; Bell & Pavitt, 1993]. This allows this paper to deliver an immediate actionable relevance to the international development community. Governance in the context of this paper encompasses how the interactions between the multiple actors responsible for

[37] Snowball sampling – Where the citations from one paper, determine ongoing targets for sampling.

undertaking the various project tasks within a megaprojects organisational structure are: identified, allocated, organised, and coordinated [Sanderson, 2012:432]. The three governance categories applied in this paper's analysis are Forecast inadequacies; Deficient complexity management; Rivalrous project goals.

### 3.2.1 Forecast inadequacies

This category of governance encompasses projects where actors with an interest in such a project development proceeding, overestimate the benefits of the project, and underestimate the anticipated project costs and duration: resulting in a more compelling business case for the megaproject to proceed. Although potentially having sinister motivations, such a category usually has a more innocent explanation: the human propensity for optimism (optimism bias). Flyvbjerg [2017b] also outlines further less sinister motivations, in his four 'sublimes'. These being: the technological sublime, where engineers aspire to work on the most noteworthy projects they can. The political sublime, where politicians want to be associated with 'signature/statement projects'. The economic sublime, where actors (e.g. trade unions wanting to create employment for their members) seek a somewhat legitimate value capture. Finally, the aesthetic sublime, where the demand for 'beauty' is prioritised ahead of cost, by aesthetically motivated parties such as pressure groups. All four of these sublimes typically relate to a public financing narrative, as only a government financier of substance is likely to have the capacity to absorb such potential value changing influences. SSA governments are unlikely to have such funding flexibility.

### 3.2.2 Deficient complexity management

As was discussed in *sec.2.2*, complexity is an inbuilt reality of all megaprojects and needs to be both appreciated and planned for, as early as the project's conception. In this paper, complexity is sub-divided into two categories: structural, complexity that is created during a project's planning; and dynamic, complexity created by changes once a project has commenced.

During planning "*the consequences of decisions will be highest, while the information will be at its lowest"* [Williams & Samset, 2010:39]. Importantly however, the cost implications of any changes required will also be at their lowest. Rushed pre-engineering and planning that leads to premature commencement of construction and therefore

revisions later, always prove costly – the more rushed, usually the more costly. Therefore, when say political decision-makers (or any primary decision-makers) are impatient for a project's commencement (and pushing for it against their agent's wishes) they are in effect condemning that project to underperformance [Brady & Davies, 2014; Maylor et al, 2008; Williams & Samset, 2010].

> *"The World Bank gave a similar message in a study based on a review of 1,125 of its projects that were evaluated between 1991 and 1994.* {It concluded} *that projects with adequate or better identification, preparation and appraisal had an 80% rate, against 25% for projects that were deficient in all these aspects; and that the quality of preparation and appraisal had significantly more influence on satisfactory performance than key country macro-economic variables, external factors, or government considerations* [Williams & Samset, 2010:39 – citing the World Bank, 1996].

The challenges caused by changes once a project has commenced, are probably more significant (*sec.2.2.2)* and must be expected, as the scale of a megaproject will always cause unanticipated factors to arise. This category includes, not having processes in place to deal with the *known knowns*, *known unknowns*, and *unknown unknowns*, highlighted by Donald Rumsfeld on 12 February 2002 in Iraq.

As the scale of projects increase: "*challenges in some areas can only be solved by introducing failures in others. Thus, megaprojects will always have to confront some degree of failure despite attempts to synthesise a coherent megaproject management strategy. Therefore, planners can either plan for failure (make value decisions going into a project) or avoid the inevitability of failure by reducing the scale of projects, focussing instead on smaller, more scalable, more flexible energy investments"* [Van de Graaf & Sovacool, 2014:26].

### 3.2.3 Rivalrous project goals

The core notion of this governance category is that to maximise the efficiency of a megaproject for successful delivery, all stakeholders and agents need to have shared goals or priorities. Governance failure occurs when a project's actors start to have misaligned goals, if not opposed interests: which will lead to project turbulence. This usually occurs at a stakeholder-to-stakeholder level but can occur between stakeholders and their agents. With an electricity generation development: at a stakeholder level, this can manifest itself

as a clash between environmental and commercial requisites, and the need to appreciate and value economic externalities [Arrow, 1970; Pigou, 1932]. Between a principal and agent, this can reflect rent-seeking or value-capture, where agents seek to extract excessive and unreasonable value, from the project [Eisenhardt, 1989; Gregory & Sovacool, 2019b; Krueger, 1974].

### *3.3 Fieldwork research questions*

By applying the three governance explanations to the six case studies, this paper's research sought to answer two questions. Firstly, if an infrastructure development has been un-successful, did one or more of the following cause this to happen? Forecast inadequacies, during the project planning; deficient complexity reducing governance arrangements; or rivalrous project goals, between stakeholders themselves or with their agents. Secondly, if an infrastructure development has been successful, were the following established: accurate forecasts, complexity reduction strategies, aligned objectives between each stakeholder and agents? Whilst evaluating the evidence received from the fieldwork, it became clear that the data collected could answer more than just governance issues. Consequentially, this paper analysis now focuses on issues of governance, scale, and scope.

### *3.4 Fieldwork methods*

This paper's fieldwork solicited data using two interview methods: originally ten inductive interviews were carried out (as part of a larger sample during an associated project), and later a further twenty-two semi-structured interviews. These were with relevant personnel who possessed intimate knowledge of at least one of the six case study projects in South Africa: **Medupi, Kusile, Ingula, Sere, Avon and Dedisa**. During the data collection, it became evident that certain potential witnesses had significant pressure exerted upon them to not confer with academics. This was probably because both Medupi and Kusile are subject to intense political scrutiny in the RSA – due to their significant cost overruns which have compromised Eskom's balance sheet [Engineering News, 31/07/2019; Eskom1; Mail & Guardian 9/01/2015; Africa Feeds, 13/02/2019; Mining MX, 1/09/207]. Fortunately for this paper's data collection, much of the relevant historic institutional knowledge, no longer just resides within Eskom – Medupi and Kusile have been under development for over 15 years, and Eskom no longer employs many of the

most knowledgeable witnesses. Most interviewees have asked the author to guard their identities – therefore, for fear of compromising any of them; a summary only of the interviewee profiles appears below. Within the text of the paper, they are cited as 'IW' (interview witness) and given a number: e.g. **IW12**.

Most fieldwork interviews were face to face, with one telephone interview, and one written set of answers. The shortest interview lasted about half an hour and the longest roughly two and a half hours. Most interviews were recorded (permission was sometimes withheld) and then transcribed. Twenty-two interviews were conducted in May/June 2019. Ten occurred earlier, at the end and beginning 2018/19 as part of a separate project. The earlier interviews were inductive, and the interviews carried out later were deductive and surrounded six interview questions.

1. What is your association with the project, and how did you come to be involved?
2. Who was responsible for the project's initiation: who sponsored it, and who were the principal stakeholders involved?
3. How was the project planned - including its design, timetable, and budget; and were there any notable stakeholder agreements or disagreements?
4. How was the construction of the project organised? – Who determined the structure, who was involved, and what issues (if any) arose?
5. Who determined when the project was commissioned, and was it completed on time and at budget?
6. Looking back at the project, what in your opinion most contributed to its problems and overruns / or if there were none – what factors led to the project's success?

**Table 3** (compiled by author)

## *Interview Profiles*

| Interviewee Code | Structure of interview | Class of Case Study Project | Position/ Expertise | Institution | Status when Interviewed |
|---|---|---|---|---|---|
| IW1 | F to F* | All Eskom | Director | Eskom | Current |
| IW2 | F to F | All Eskom | Director | Eskom | Current |
| IW3 | F to F | Problematic | Engineers | Eskom | Current |
| IW4 | F to F | Problematic | Manager | Eskom | Current |
| IW5 | F to F | Problematic | Senior Management | Eskom | Current |
| IW6 | F to F | Problematic | Senior Management | Contractor | Current |
| IW7 | F to F | Problematic | Engineer | Eskom | Past |
| IW8 | F to F | Problematic | Senior Management | Eskom | Current |
| IW9 | F to F | All Eskom | Senior Management | Eskom | Current |
| IW10 | F to F | Successes | Engineer | Eskom | Current |
| IW11 | F to F | All | Energy Journalist | Publisher | Current |
| IW12 | F to F | Successes | Senior Management | Contractor | Past |
| IW13 | F to F | Problematic | Engineer | Eskom | Past |
| IW14 | F to F | Successes | Senior Management | Eskom | Current |
| IW15 | F to F | Problematic | Senior Management | Eskom | Current |
| IW16 | F to F | Problematic | Management | Eskom | Past |
| IW17 | F to F | Problematic | Management | Supplier | Current |
| IW18 | F to F | Problematic | Senior Management | Eskom | Past |
| IW19 | F to F | Problematic | Senior Management | Contractor | Past |
| IW20 | F to F | Successes | Senior Management | Shareholder | Current |
| IW21 | F to F | Successes | Senior Management | ADPP** | Current |
| IW22 | F to F | Problematic | Management | Eskom | Past |
| IW23 | F to F | Problematic | Senior Manager | Industry | Current |
| IW24 | F to F | Problematic | Senior Management | Eskom | Past |
| IW25 | F to F | Successes | Senior Management | ADPP | Current |
| IW26 | F to F | Problematic | Senior Manager | NGO | Current |
| IW27 | F to F | All | Senior Manager | NGO | Current |
| IW28 | F to F | Problematic | Senior Manager | Eskom | Past |
| IW29 | F to F | Problematic | Senior Management | Industry | Current |
| IW30 | F to F | Problematic | Senior Management | Eskom | Past |
| IW31 | Telephone | Problematic | Engineer | Eskom | Current |
| IW32 | Written | Problematic | Consultant | Eskom | Past |

***F to F =** Face to Face

****ADPP** = Avon and Dedisa Peaking Power

# 4. Case study context and selection

This section will now explain the complex socio-technical environment that the six case-study electricity generation projects were built within. Firstly, this involves a recent historical background surrounding Eskom, starting in the 1970s and ending in April 1994, when the ANC took over government. This is important as Eskom represented the entire RSA's electricity supply industry during this period, and therefore any legacy issues that existed within Eskom when the ANC took power, need appreciating. Next, I will briefly analyse the three most influential socio-political undercurrents that impacted the case study context, after the ANC took power. This is then followed by a summary of why there has been both a lack of leadership and policy indifference surrounding electricity supply in the RSA, since the political transition. Next I describe Eskom's current standing and condition; and finally, I will explain the case study selection.

## *4.1 Eskom, an institution formed by history*

Eskom, as the national electricity utility of the RSA, is a vertically integrated, 100 percent owned, corporate entity of the country's central government. It itself, owns and manages the country's electricity transmission grid and is responsible for generating most of the country's electricity needs – what should be a clearly defined function, for this type of institution. However, over the past half century, the extent of the company's responsibility and control have been markedly restricted in both reach and autonomy, which has left a legacy of frustrated managerial aspiration within the institution and path-dependent trajectory of behaviour. This makes Eskom, like many significant institutions throughout the world, both a carrier of history and a hostage to it [David, 1994].

The modern Eskom had started to take shape in the 1970s, when it was still called ESCOM, (an anacronym for the Electricity Supply Commission). By this stage, ESCOM had automated and unified the country's entire electricity generation fleet into a centralised national-grid, which it controlled using five operators from a hub in Simmerpan (completed in 1973) [Christie, 1984 – cited by Gentle, 2009]. As part of this centralisation, it also undertook an aggressive expansion program of building several very large pit-head, coal-fired power stations throughout the country's coal regions [Gentle, 2009; Eberhard, 2007]. It should be noted, it was during this time, that both the development locations for Medupi and Kusile, were originally identified [**IW30**]. It is also important to observe, that "ESCOM had also become a strategic arm of the then

apartheid regime's geopolitical objectives" [Gentle, 2009:62], which permitted it to have considerable autonomy in how it strategically planned its own business, as its strategy was deemed synonymous with that of the state. This is when a culture of *what is good for Eskom, is good for the state*, started to dominate the organisation's thinking **[IW1, IW2]**.

This aggressive power generation building program however, demonstrated the fallacy of the organisation's leadership and exhibited for the first time the institution's ability to damage the entire country economically. The aggressive expansion of capacity, partly paid for by higher tariffs to the angst of its important customers, had created a significant excess in generation capacity. "*By the end of 1983, ESCOM had 22,260MW of generating capacity on order, double the capacity then being operated*": the outlay for which, the country and its industry could ill-afford [Eberhard, 2007:219 – citing Steyn, 2001:75].

This capacity expansion had been mainly financed by international bank lending, who as a community, were initially enthusiastic lenders when the program started, particularly as such lending received sovereign guarantees. As the decade progressed however, this willing sentiment turned against both the country's apartheid regime and ESCOM. By 1985, after anti-apartheid civil unrest had intensified and the gold price had collapsed (a major determinant of sentiment surrounding South Africa's perceived solvency) the government was forced to declare a moratorium on debt repayment – a situation shaped by ESCOM's spending [Gentle, 2009; Eberhard, 2007]. Notwithstanding, the apartheid government had already begun to question ESCOM's autonomy.

In 1983, the De Villiers commission had been established to examine both ESCOM's strategic exuberance and electricity pricing throughout South Africa. The commission in its findings, heavily "*criticised ESCOM's governance, its management, its electricity forecasting methods, its investment decisions, and its accounting*" [Eberhard, 2007:219]. Its conclusions included: that there should be a unified and commercial national electricity tariff, and ESCOM should cease being a public-interest parastatal (since its creation in 1922, ESCOM had to operate at cost and guarantee electricity supply, which meant it could recoup its development costs through its tariff). The new status was meant to require ESCOM to operate as a commercial company: making profits, paying taxes and dividends to its owner, the state [Gentle, 2009; Eberhard, 2007].

In 1987, with the international backdrop of neo-liberal public management changes which started in the US and the UK (now known as New Public Management [Hood,

1991]), two new Acts were passed by the RSA government. The Eskom Act 1987 and the Electricity Act 1987. Amongst other things, ESCOM was renamed Eskom; and its supervision was reconfigured, to permit input from important customers – but this occurred with unintended consequences, as ESCOM's lawyers were allowed important input into the legislation, which resulted in reduced regulatory oversight of tariffs [Eberhard, 2007:220]. The company also began its journey towards corporatisation and its modern status. Importantly, no new power stations were then ordered until 2005, the context of this paper's fieldwork.

Due to the changed status that the two acts had created, Eskom then entered the 1990s with the apartheid government exploring ways to privatise the company. This was not just driven by neo-liberal ideology, it was also an attempt to de-politicise the institution, whilst finding a sensible solution to remove the financial burden and legacy that Eskom's expansion just discussed, had placed on the state's balance sheet [Greenberg,2007]. The ANC however, due to the expectations that they had built amongst their supporters over their years of struggle, were openly hostile to such a notion, and openly threated to renationalise Eskom if privatisation was carried out. So, privatisation was shelved, and the company remained in public ownership as the ANC took over the leadership of the country and Mandela became president [Ibid].

## *4.2 The post-apartheid socio-political topography*

Since the political change in leadership in April 1994, there have been a number of supplementary but important socio-political themes that have influenced the topography of this paper's analysis**.** The three most significant surround the topics of *black equity*, *trade union influence* and *state capture*. This sub-section will now briefly unpack these three themes and clarify how they have also influenced the empirical research context.

### 4.2.1 The pressure for Black Equity

There were many expectations demanded of the new ANC government, on their ascension to power, with one of the principal ones being a desire to rebalance the economic input from non-whites, in the country's economy – or promoting 'Black Equity', as the policy is often described. Due to their public ownership, the nation's parastatals were top of the list of institutions for redress and Eskom was certainly one organisation that was expected to change. Fortuitously for Eskom, the top management

had not waited for the formal political transition to occur before starting this process of redress, instead they had already commenced a policy of racial rebalancing within the institution much earlier, under the leadership of Dr Ian McRae in 1990 – when they actively started to recruit black engineers [**IW1, IW3, IW4, IW5, IW7**]. There was foresight in this move, as it enabled a training of a new black middle management in the necessary capabilities to run the company, much earlier than might otherwise have been possible – potentially enabling a less disruptive transition. In a wider context however, Black Equity was probably also responsible for many of the leadership issues surrounding Eskom, discussed in the coming **section 4.3** – which has led to many of Eskom's other problems.

The policy of advancing Black Equity did not just impact the context of Eskom directly through its impact on its leadership, it also had an issue through another type of policy for racial-redress: the BBBEE (Broad Based Black Economic Empowerment) policy. The ambition of BBBEE is to distribute wealth across as broad a spectrum of the previously disadvantaged South African society as possible. This policy had direct relevance to the construction of the Eskom sponsored case studies, and the ownership of the independent ones. This is discussed in more detail in section 5.2.3 of this Chapter, where the policy's influence, and other Black Equity measures, are explained.

### 4.2.2 The influence of Trade Unions

Before the political transition, the South African trade union movement under the leadership of COSATU (Congress of South African Trade Unions), was arguably the most effective force for racial-political change in South Africa [Jerome, 1997]: as they were involved in numerous political activities that had more to do with promoting racial political change, than might normally be anticipated from a trade union movement.

> These included: *"getting the government to free political prisoners; developing a mechanism to create a new constitution; drafting the new constitution; educating South Africans about government processes and voting procedures; conducting public debate about democratic institutions; aiding in plans for the 1994 election, assisting in the first all-race election, conducting the successful election of the ANC, forming the 'New Government of National Unity', persuading the USA and other countries to lift bans and sanctions, encouraging foreign investment, and encouraging domestic companies to invest in developing the new South Africa"* [Ibid: 37].

Although never formally part of the ANC, COSATU's influence over the ANC and its input of people into its senior ranks, even before it took over government, is clear to see.

Perhaps the greatest evidence of this is visible through COSATU's pivotal role in the making of Cyril Ramaphosa politically, the current president of the RSA. Ramaphosa's political reputation was initially created as the leader of the NUM (National Union of Mineworkers) – a creation of COSATU. Ramaphosa followed this role by transferring to the ANC as its Secretary-General in 1991[Butler, 2007].

The relevance of this link for Eskom, lies primarily with the issue of coal. Eskom depends on coal as a fuel, from which to generate most of its electricity – and appears to be committed to this source of energy, as they are building two brand new 5GW power stations in the form of Medupi and Kusile. COSATU's relevance to coal, is that they facilitated the creation of the NUM under the leadership of Ramaphosa in 1982, when they were still CUSA (Council of Unions of South Africa). The NUM continues to represent most of the Coal miners in the country and are therefore keen to continue to support the coal industry's *raison d'etre*. As will also be demonstrated in sec 5.2.3, the trade unions were very active in protecting their members interests, during the building of Medupi and Kusile.

### 4.2.3 The effect of State Capture

The term *state capture* describes a distinct category of administrative corruption (the misuse of public office for private gain [Booth, 2012; Godinho et al, 2018; Gregory & Sovacool, 2019b]), where the political corruption is systemic and utilises embedded networks of power and influence. This involves both public and private actors colluding, to co-opt the mechanisms of state for their own economic joint benefit – cheating the normal social contract and the wider societal interests [Godinho et al, 2018; Madonsela, 2019]. Despite the applicability of the term, for describing the apartheid process of control of the pre-1994 South Africa – in the South African context, it is usually used to describe how President Jacob Zuma was able to use the power of the office of President, to appropriate value towards his own network of interests, which included the Gupta family and other non-state interests [Godinho et al, 2018, Madonsela, 2019]. Its relevance to this paper, is that as a process it was applied to Eskom and forms a legitimate contributing input for what may have gone wrong with the Medupi and Kusile case studies.

As applied to Eskom, state capture was a political-economic project, that had several stages to it. Firstly, it was necessary to place sympathetic political officials in the ministries and trade unions that surround Eskom (see sec.4,3); next, the members of

Eskom's board were replaced with new directors sympathetic to the network's goals and who would be prepared to appoint a senior management who were part of the network. Once these processes are completed, the network is then able to corrupt procurement processes of Eskom and any megaprojects that it is building – the larger the better – to appropriate value for the network [Godinho et al, 2018]. Evidence arising from the 'Zondo Commission of Enquiry into State Capture[38] , suggests this is what happened [Ibid]. It should be noted that Zuma did not become president until May 2009, after all the Eskom case studies had all been commissioned. There is also no suggestion of any impropriety before his accession to the presidency, or directly after it, within Eskom.

### *4.3 Electricity supply: a leadership and policy vacuum*

Since the accession to power by the ANC in 1994 to the present day, there has been much confusion surrounding Eskom's strategic leadership and direction. The political supervision of Eskom is the responsibility of the Department of Public Enterprises (DPE), whose minister frequently changes, leading to sub-optimal governance surrounding Eskom from the government – the current responsible minister is Pravin Gordhan, who has been in office since February 2018. As I explained in sec.4.2.3, it has also become customary for the President himself to take oversight, due to the significance of Eskom's economic power.

Further, as a corporation, it is also subject to the control of its own board and CEO, both of which have again been frequently changed. In the earlier days, as the policy of black empowerment took hold on Eskom, it led to conflicts between the CEO and the board and the board and its political masters (see sec.4.2.1) as the company transitioned from an apartheid legacy to an ANC one. More recently, it has led to conflict between the board and its political masters, as the costs and disruption of load-shedding and Medupi and Kusile's development have come home to roost. The current CEO is Andre de Ruyter, who has been in office since January 2020 and is the 11th CEO in ten years; the current chairman Malegapuru William Makgoba, is an interim appointment, made in January 2020.

As an energy utility, Eskom is also subject to the policy oversight of the department of Energy (DoE) and before that department's creation, the department for Mining and

[38] https://www.sastatecapture.org.za/

Energy (DME). Again, the ministerial leadership of this body has also been subject to frequent change. This has created a policy vacuum surrounding electricity supply in the RSA. This has perhaps been best illustrated by the DME *White Paper on the Energy Policy of the Republic of South Africa*, [1998].

The Whitepaper was meant to deliver a road-map for the country's future electricity supply policy and details a policy of restructuring and liberalisation of the electricity supply industry (ESI). To this end, it made several important transitional recommendations.

1. The unbundling of Eskom Generation into a number of competing generation units.
2. The diversification of ownership within the generation sector through local and international private sector participation.
3. Exclusive private sector involvement in any new-build, to reach a target of 30% of generation capacity - prohibiting Eskom from building any new power stations.
4. The separation of Eskom Transmission from Eskom Generation, to enable non-discriminatory access to the transmission grid from new suppliers.
5. The creation of a wholesale energy market in South and Southern Africa.
6. The rationalisation of about 190 municipal and Eskom electricity distributors into a limited number of economically viable, wall-to-wall, regional electricity distributors.
7. The introduction of competition into the industry, especially the generation sector, and giving customers the right to choose their electricity supplier.

Whilst some movement did occur to implement the restructuring of the ESI, it became clear that most of the embedded interests within the socio-political establishment were against any such change, including the provincial and local government levels of government. Eskom and the municipalities had little appetite to appetite for change too. The result has been ongoing policy uncertainty, as without adequate political and executive leadership and direction, how can change occur? In 2020, twenty-two years on, the stated policy objectives of the 1998 whitepaper remain in place, and there is still heated discussion about what to do.

## *4.4 Eskom's status and condition*

Traditionally, Eskom has generated most of its electricity from South African sourced coal, but its extensive coal fired generation fleet "*are between 37 and 50 years old and many operate at sub-optimal levels due to their age"* [Quote by Minister Gordhan, as reported in Biz News, 17/03/2019]. South African coal has a relatively high and variable non-combustible content, which includes quartz and alumino-silicates, which create highly abrasive fly ash[39] [Moumakwa & Marcus, 2005; Falcon & Ham, 1988]. This is problematic to protect against and leads to excessive plant shutdowns – particularly if the quality of coal burned is of an inconsistent quality (which makes it difficult to engineer protection against). Evidence arising from the current 'Zondo Commission of Enquiry into State Capture' surrounding Matshela Koko (former acting Eskom CEO), has demonstrated through its hearings, that corruption in recent years had led to variance in coal quality [Times Live, 11/03/2019].

Eskom is often forced to lose a significant percentage of its current generation capacity, because of technology induced, unscheduled capacity shutdowns within their coal fired generation fleet [ENCA, 19/03/2019]. This then leads to load-shedding within the grid (controlled blackouts) throughout the country - its problems have been most acute during peak demand periods and have accelerated in frequency over the last year. The consistent load-shedding is perhaps the most significant economic issue facing South Africa currently

## *4.5 Case study selection*

Eskom owns and operates four of the case studies used in this paper. Two of these are massive coal fired generation projects, Medupi and Kusile, each with an expected 'plate' generation capacity of 4,800MW once completed (amongst the largest in the world). Medupi (located in Limpopo province) was originally supposed to be finished in 2013/14 and Kusile (located in Mpumalanga province) in 2014/15 [**IW11; IW19**; **IW30**], but neither is fully constructed yet. Medupi is anticipated for completion in 2020 and Kusile in 2023 [Business Day, 4/09/2019]. The initial budget was R79bln[40], and there are no

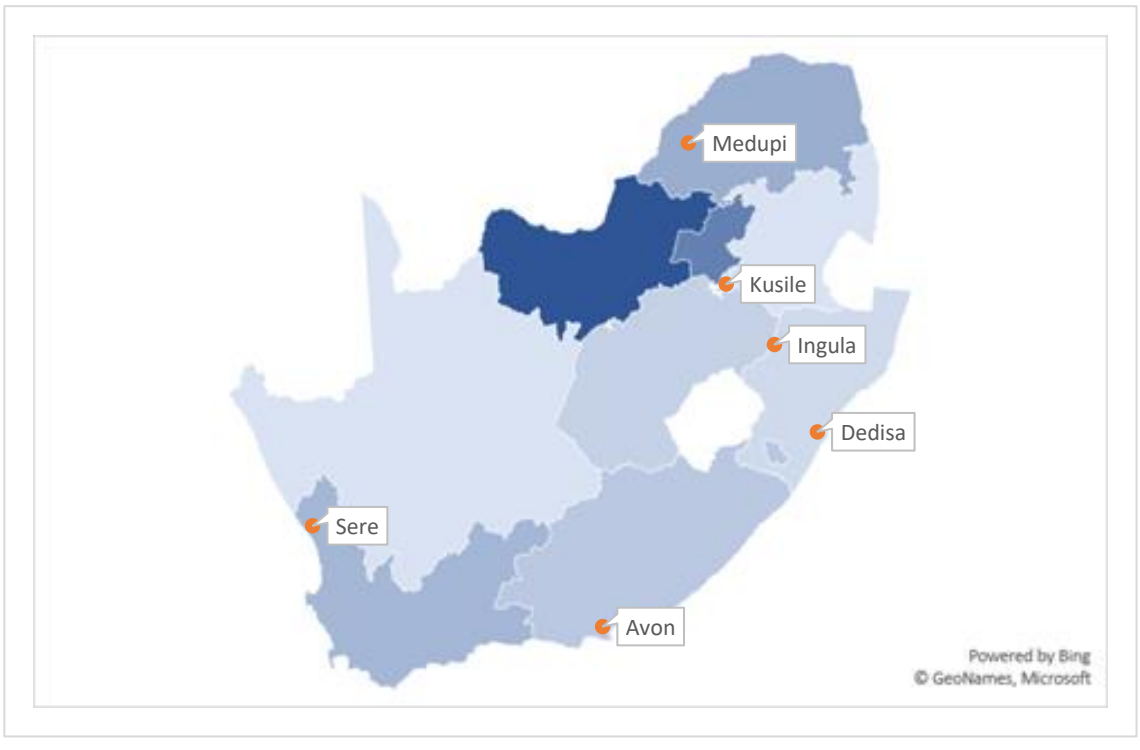
[39] Fly ash – Small particle combustion residues, which are difficult to extract from the combustion exhaust, and therefore flow into through the boiler system. [Moumakwa & Marcus, 2005]

[40] R = Rand; bln = Billion

confirmed final costs, but a 200% plus cost overrun represents a realistic possibility. The third is Ingula, a 1,332MW pump storage facility: where an underground powerhouse complex, which contains four reverse flow pump turbines and four generator transformers, connects two reservoirs – this facility straddles the Free state and Kwazulu-Natal border [Eskom 2]. The development cost was just under R30bln (US$2 billion), and understood to be 33% over budget, having suffered delays of over 4 years (+80%) [**IW31**]. All three projects are megaprojects, consistent with Flyvbjerg's [2017] definition (see *sec.2.1*); and all three have been problematic in terms of budget and schedule.

The fourth Eskom generation asset is the Sere wind farm, located in the Western Cape, which has a technical capacity 100MW: which some might argue should not qualify as a megaproject. The project cost approximately R2.7bln [**IW10**] – which was around US$375 million in 2011/12, when the project was commissioned. It is still included, as it exists within the complex socio-political structures that make up the South African electricity delivery landscape, and subject to its complexities: the primary qualifying feature for defining a megaproject in SSA in this paper (*sec.2.1*). Perhaps more importantly, it is an example of an Eskom successful project delivery, in contrast to the first three. It also utilises a technology that is unique within Eskom, and novel to the organisation.

**Figure 7.** *Location of case studies, within South Africa*



The last two case studies are two privately-owned, peaking power plants, which utilise two open cycle gas turbine power plants and together cost R10bln [Avon & Dedisa Peaking Power]. They are located on the Eastern coast of the country: Avon near Durban, and Dedisa near Port Elizabeth. Each plant was designed to supply electricity as peak demand facilities to augment the electricity grid when required. During the recent electricity outages in the RSA, these two plants have provided electricity outside this peak period, with no problems. Avon's capacity output is 670MW, and Dedisa is 330MW.

# 5. Results

## *5.1 The organisation of data for analysis*

In this paper's analysis: case studies 1, 2 & 3 are regarded as problematic, as they have gone over budget and beyond schedule; case studies 4, 5 & 6 are regarded as successful, as they were completed within projected timeframes and budget. Sere (case study 4) was late in its connectivity to the South African grid, but its generation component was completed on schedule: the delay was due to a complex negotiation with landowners over transmission land rights, which delayed the connectivity of the project to the grid **[IW12]**. In line with this paper's research questions, this paper combines its case studies together into two separate groups: the problematic and the successful. It then applies each of the three governance perspectives explained in *sec.3.2*, to the two groups.

## *5.2 Medupi, Kusile and Ingula: the problematic*

### 5.2.1 Forecast Inadequacies: governance explanation one

This section analyses the applicability of ***Forecast Inadequacies*** as a suitable governance explanation for the development failures of the first three case studies. Here the evidence suggests a reluctance to build new generation capacity by government (as opposed to enthusiasm) and there is no evidence of optimistic projections (central to this type of governance failure). Once a decision to proceed with the development of new generation capacity however, the process was enthusiastically embraced and mishandled.

Several interviewees suggested that Eskom pushed aggressively within government for at least a decade, for permission to start building further electricity generation capacity

**[IW11**; **IW18**; **IW22**; **IW30].** Its requests to build were consistently rebuffed: first by the Mandela government (1994-1999) and then the Mbeki government (1999–2008), as these two democratic administrations both prioritised Eskom's focus towards the connectivity of electricity-disenfranchised people, over building new generation capacity [Eskom 3]. There is a larger narrative that surrounds this reluctance to build, but the explanation and analysis of this is beyond the scope of this paper.

- In December 1998, the South African Department of Minerals and Energy produced a White Paper on the Energy Policy of the Republic of South Africa where it stated: "*Timely steps will have to be taken to ensure that demand does not exceed available supply capacity and that appropriate strategies, including those with long lead times, are implemented in time. The next decision on supply-side investments will probably have to be taken by the end of 1999 to ensure that the electricity needs of the next decade are met"* [Department of Minerals and Energy, 1998:53] – But no change in government policy occurred following the white paper's release, for over five years.

- President Mbeki went on record to apologise in early December 2007, after load-shedding had commenced *"When Eskom said to the government, we think we must invest more in electricity generation ... we said not now, later. We were wrong, Eskom were right, we were wrong."* [Quote relayed by IOL, 12/12/2009]

- Interview **IW16** said a "*decision was taken by government to proceed with Medupi in 2003, but it was quickly reversed after the Eskom board approved the return to service"*: the recommissioning of three mothballed plants: Camden, Grootvlei and Komati [supported by **IW11**].

The government only relented after Alec Erwin became the minister for DPE, in 2004. In late 2004, the minister was finally persuaded to reverse the government's position with irrefutable evidence of impending electricity capacity shortfalls, when Eskom senior management were finally able to get a focussed meeting with him. "*Once we persuaded him, Erwin then enthusiastically championed the three projects through cabinet in early 2005"* [**IW30**] – and beyond.

The basis for Eskom's own enthusiasm for construction to commence, was also rooted on solid ground – their own analysis since the 1990s had demonstrated that demand was going to exceed supply by late 2006, and serious load shedding had become reality to

South Africans, by the end of 2007. "*Electricity demand was increasing, as tariffs were being kept low by NERSA* {the regulator} *to encourage industrial growth, and the government's electrification program was increasing connectivity*" **[IW30]**, and therefore consumption of electricity. Despite the government's reticence, *"we embarked on a 'desktop' development* {no pre-engineering} *of 3 new coal generation projects: 'Alpha' 'Bravo' and 'Charlie', using the Majuba schematics*[41] *to deliver equipment factor estimates*". "*We had also planned for several peaking power solutions, which we developed under the 'Brownhook model'*[42]*: a pump storage project, which became Ingula, and two open cycle gas turbine plants, Ankerlig and Gourikwa",* both located in the Western Cape **[IW30]**.

Alpha, Bravo and Charlie are in fact significantly different to Medupi and Kusile – and therefore these projects anticipated budgets and construction timetables should not be applied as reference points for the project's cost and timetable forecasts, even though they are often used as such. All three projects were desktop or concept only – initially 3 x 600 MW (1800MW) generation plants, using sub-critical technology, with an anticipated budget of R35bln each. In late 2006 they became two 6 x 800MW (4,800MW), when the projects were expanded and had super critical technology applied[43]. Alpha and Charlie were merged to create Medupi, and Bravo was scaled up to become Kusile. Their initial proposed budget was finally set in 2007 at R79bln each. In 2009, their budget was escalated by the board to R92bln for each project; increased again in 2010/11 to R105bln; and again, to R135bln in 2013. Three separate interviews have confirmed aspects of this reality **[IW11; IW24; IW30]**.

[41] Majuba was Eskom's most recently constructed large coal-fired power station: commencing in 1983; suspended in 1985, for financial reasons; and after substantial delays, completed in the middle/late 1990s.

[42] **Brownhook Model**: a 'ring fenced' development/finance model, which delivered future ownership flexibility consistent with the then government policy **[IW30]**.

[43] **Sub and Super critical technology** – "Super-critical refers to a system operating at above 22.1MPa (3206 psi) and 3740C, called the critical point for water. Water at or above this pressure remains liquid, i.e. it does not boil into steam at any temperature. The net result is, as far as boiler design is concerned, that you are dealing with a liquid not a gas, hence heat transfer is improved. So, a boiler designed to operate in the super-critical regime can be slightly more thermally efficient, by several % points, depending also on several other factors. If your boiler is burning, say 3 million tons of coal a year, every % of improvement in efficiency is valuable, cost-wise, and especially since less coal for a certain electrical output equates to reduced CO2. Finally, since a super-critical boiler does not have to separate the steam and water, it does not need a (steam-separation) Drum and may thus be a bit easier and cheaper to build" **[IW24]**.

### 5.2.2 Deficient complexity management: governance explanation two

As discussed in *sec.2.2*, it is the inability to manage the complexity of megaprojects, which is often at the core of megaproject failure (which is also an important project capability issue). It can be inferred from this that a failure to not only reduce complexity, but to increase it instead, must indicate an absence of appreciation of such a detail amongst the responsible decision makers behind the commencement of these three megaprojects. The previous time Eskom had been involved in constructing a major power generation project, from start to finish, was in the early 1980s (except Majuba – see earlier footnote) [**IW11**; **IW13**; **IW19**; **IW22**; **IW24**]. By 2005, the capabilities for constructing a megaproject, particularly the EPC skills, had long departed Eskom [Ibid]. It can be argued that should have dictated caution and a drive towards complexity reduction. Instead, Eskom commenced developing three megaprojects simultaneously; and making two of them, Medupi and Kusile, even more complex than they had to be.

#### *5.2.2.1 MAKING MEDUPI AND KUSILE MORE COMPLEX*

"*Traditionally when Eskom had built its large power stations, it would have divided the construction process into 4, 5 or 6 work packages, surrounding: civil works; boiler works; turbine hall* {turbines/alternators/air cooled condensers}; *control & instrumentation; coal supply. Further, Eskom would not have proceeded with utilising 'prototype equipment'. With both Medupi and Kusile they broke these rules*" [**IW24**, supported by **IW11**; **IW22**; **IW30**]:

- *"They built to a scale and complexity, that Eskom had never built to before"* [**IW24**].
- *"They used a technology that they and their contractor* {Hitachi Power Africa} *had never used before"* [**IW24**] – super critical boilers. Flu gas desulphurisation, was also novel to Eskom;
- *"Medupi has at least 39 'key' work packages, two of which were not managed by the project"* [**IW24,** supported by **IW22**].
- *"Kusile has over 50 'key' work packages"* [**IW24**].

If the number of work packages were limited, Eskom would transfer project risk to the contractor: as the responsibility for everything within the work package lies with them, including the performance of their sub-contractors. By disseminating the traditional work packages, into the number they did – Eskom did two negative things for themselves: they

made the development process far more complex and problematic; and they transferred the consequences of this complexity, from their contractors to themselves.

Eskom then compounded this issue, by failing to benefit from the learning curve through 'learning by doing' [Scott-Kemmis & Bell, 2010]. When building something novel to your organisation, you can learn both 'how to do it better', and 'what not to do again'. Rather than building Kusile after Medupi was finished, and applying the lessons learnt from Medupi to the Kusile project, before construction had started and a mistake ridden trajectory was 'locked in' (*sec.3.2*) – Eskom overlapped the building of both projects, with a delayed commencement of Kusile.

Finally, there was a lack of appreciation of the global context, which should have also dictated caution surrounding scale and scope. At the point that Eskom embarked on building Medupi and Kusile, there was a global boom surrounding the construction of coal fired, electricity generation, power stations. "*China was commissioning on average a new 2x600MW coal power project every month and to a lesser extent India"* was also expanding this type of electricity delivery technology as well **[IW24]**. The outcome of this was that it was a seller's market from a technology perspective: with only weaker technology providers available as suppliers to Eskom; and no availability for utilising turnkey contracts, to transfer construction and technology risk away from Eskom's balance sheet – as traditional facilitators felt no pressure to accept such risk to secure business **[IW11**; **IW24]**.

From a project capability and management skills perspective, this was also a problem: as the relevant skilled personnel who had been involved in building earlier Eskom large capacity power stations, had departed Eskom **[IW3**; **IW11**; **IW16**; **IW19**; **IW22**; **IW24]**. Eskom were unable to hire suitably skilled personnel locally or from overseas. Neither Parsons Brinckerhoff (PB Power Africa) or Black and Veitch, the respective 'owner's' engineer for Medupi and Kusile, had knowledge of supercritical technology with South African low calorific coals for example **[IW24]**, which require boilers to have a higher burn capacity to enable the required higher temperatures to be reached [Falcon & Ham, 1988]. Hitachi Power Africa also lacked this knowledge, the boiler contractor for both power stations. Regarding civil construction skills, South Africa was also simultaneously building multiple large-scale stadia, for the 2010 soccer World Cup **[IW8**; **IW22]**. The lack of available staff with proficient welding skills was mentioned during many interviews.

#### *5.2.2.2 RUSHED DESIGN AND FRONT-END ENGINEERING*

Medupi commenced construction in May 2007, Kusile in 2009 (delayed by the 2008 Global Financial Crisis) **[IW19; IW22]**, despite both projects only receiving cabinet approval in early 2005 – this again proved to be particularly problematic, in line with the issues described in *sec.2.2.2*. **IW16**, who since departing Eskom has been associated with many large-scale infrastructure projects throughout Africa, said: "*projects of the size of both Medupi and Kusile require at least 10 years of front-end design and engineering before construction should have commenced"*. Regardless of what the correct figure is, as the Eskom controlled electricity delivery system reached capacity in 2007 – the political expediency to commence construction from the DPE, for fear of impending power cuts, determined a quick commencement **[IW16; IW19; IW22]**.

The problems caused by this rushed start are numerous and important but mostly outside the conceptual approach of this paper. The most significant issues that caused meaningful cost increases and schedule delays are covered here briefly:

- **Strain on local manufacturing capacity**. As Eskom is government owned, it is subject to several government policy initiatives, the two principal ones being: Broad Based Black Economic Empowerment (BBBEE) and local content procurement rules. The size of orders created off these three projects, overwhelmed the local supply industry: in both product and skilled personnel. Continuously changing design specifications then compounded this (see 'Boiler issues' below). The resulting procurement delays would then affect other work packages, as dynamic complexity issues were triggered **[IW22]**.

  Ingula was *"forced to reject some of the contractor tenders, as they did not comply with BBBEE. This caused delays in the awarding of some contracts"* (some contracts took three tenders before they qualified) **[IW31]**. As this delayed the commencement of certain structural components/sub-routines, it turned structural complexities into dynamic complexities, which grew in significance through non-linear error growth (see *sec.3.2.2*).

- **Geological problems and civil works**. Rushed commencement caused geotechnical problems for both Medupi and Kusile **[IW4**; **IW11]**:
  - **Medupi** – Upfront work to understand geological conditions was incomplete, *"which lead to 'over blasting' during bulk excavation.*

*This caused damage to the bedrock, which in turn increased cost and delayed the completion of the civils"* **[IW11]**.

"*Roshcon, an Eskom subsidiary, was doing the blasting"* **[IW11]**.

*"The actual slope of the bedrock was also discovered to be worse than expected after the construction of the boiler and turbine bases had commenced"***[IW11]** – to partly resolve this, the order of construction of the individual six units was reversed: Unit 6 was constructed first **[IW4**; **IW11]**.

- **Kusile** – "*The slope of the Kusile bedrock was even worse than at Medupi"*. This required unplanned extensive piling – which significantly increasing civil work costs and creating meaningful delays **[IW11]**.

- **Boiler construction: the novelty of supercritical technology**. As already discussed, super-critical technology was new to Eskom and Hitachi Power Africa; and when combined with South African coal, new to the two-individual project's 'owner engineers': Black & Veitch and PB Power Africa. The engineering for super critical boilers is dramatically different to traditional sub-critical boilers **[IW24]**. It became very clear during construction that Hitachi Power Africa, were not suitably qualified to deliver the boilers **[IW11**; **IW24]**:
  - *"There were several high-level interventions required between Hitachi and Eskom, to get the boilers to requirement"* **[IW11]**;
  - "*Welding was sub-standard and required redoing, which then required post-weld heat treatment to relieve stress in the surrounding metal"* **[IW11]**. Super-critical boilers run at significantly higher pressures, than sub-critical boilers, requiring a very different configuration **[IW24]**.

Ingula, unlike Medupi and Kusile, was relatively strait forward, and non-complex. After Erwin received cabinet approval in 2005, it commenced quickly as its development had occurred under the Brownhook model, which permitted 10 years of planning **[IW30]**. The principal issue causing project failure, which could have been planned for, was a deficient interpretation of the South African 'Health and Safety' (H&S) law. Eskom had anticipated that H&S issues were the responsibility of the

contractor. However, the Ingula Project was deemed to be a 'mine' for issues of H&S, and as such the South African law made this issue very clearly to be the responsibility of the owner – Eskom – so any costs associated with delays caused by H&S issues, were Eskom's too **[IW31]**. There was then *"an incident that led to the death of 6 people underground, which caused a 14-month delay"* **[IW31]**.

### 5.2.3 Rivalrous project goals: governance explanation three

Rivalrous type governance failure occurs when a project's *actors* start to have misaligned goals, if not opposed interests. The natural assumption from anyone not familiar with megaproject governance might be to assume that the development goal of any infrastructure project is always straightforward: to create usable and cost competitive electricity for the RSA electricity service network, in the context of this paper. On closer analysis, particularly when a 'public' institution such as a government sponsors the megaproject, this is often not the case. Principal stakeholders can often have differing priorities for the project; and at an agency level, evidence often suggests that certain *actors* are more interested in maximising their own value extraction, rather than supporting the efficiency of the project development. This has occurred with the first three case studies, but in different ways.

South Africa, dating back to the apartheid era, practices a 'Developmental State' agenda: where the government dictates that its state-owned institutions operate in a manner consistent with its industrial policy [Bond, 2008]. This agenda prioritises skill development, employment outcomes and national strategic values, alongside the businesses principal *modus operandi*. Further, certain senior members of the ANC, such as Alec Erwin, regarded megaprojects as effective ways to achieve policy goals of 'Black Empowerment' and employment growth [Ibid].

At the political stakeholder level, interviews **[IW1**; **IW7**; **IW9**; **IW16**; **IW22]**, said that there were in effect three primary policy agendas surrounding Medupi and Kusile – and to a lesser extent, with Ingula. These three agendas were: to hastily add sizeable new electricity generation capacity to the South African Grid; to skill and knowledge train the next generation of engineers and managers of Eskom, to reflect the country's demographics; and to create a Keynesian type economic pump prime event, for two economically weak regions of the country - Limpopo and Mpumalanga provinces.

To support the developmental state agenda, Eskom created in 2010 the Supplier Development and Localisation (SDL) department, whose function was to ensure that the benefits of the Eskom infrastructure developments, were shared with the localities they were situated within [**WI16; WI24**].

> The SDL's mandate was *"to achieve maximum and sustainable local development impact through leveraging Eskom's procurement spend in a manner that allows flexibility within the business in order to accommodate government local development initiatives and policies"* [Eskom 4]. It's six priorities were to enable and/or increase: *a) Local content; b) Local content-local to site; c) Procurement from large black suppliers (LBS); d) Procurement from black women owned (BWO) suppliers e) Procurement from small black enterprises (SBE); f) Skills development"* [Eskom 5].

The creation of the SDL to ensure that Eskom's major developments were consistent with certain major policy initiatives of the South African Central Government. These being: ASGISA, BBBEE, NIPF, IPAP, CSDP, NIPP, NGP/NDP[44]. The suggested cost to Medupi alone, was suggested to be R6bln [**IW24**] – and the existence of the SDL, is likely to have contributed to the creation of so many key work packages.

At the agency level, a high-profile example of unaligned interests was the Unions prioritising the longevity of work over productivity. "*Industrial stoppages were numerous, violent, and some substantial in length – one Kusile stoppage lasted eighteen-month and the site offices have been burnt to the ground several times"* [**IW19**]. A noteworthy problem identified, was that the unions did not differentiate between contactors, when it came to employment. When a termination for non-performance of a contactor occurred – and therefore the contactor's employees lost their jobs – this became a project wide problem industrially, making it very difficult to manage poor performance of contractors (see *sec.6.6*). Contractors were equally happy to be paid for 'standing time', whilst waiting for other contractors to catch up with the official project schedule (due to any delays). Standing time and other value issues associated with third party delays were chargeable - increasing the value of their contract [**IW19**].

[44]ASGISA = Accelerated and Shared Growth Initiative for South Africa; BBBEE = Broad Based Black Economic Empowerment; NIPF = National Industrial Policy Framework; IPAP = Industrial Policy Action Plan; CSDP = Competitive Supplier Development Programme; NIPP = The National Industrial Participation Programme; NGP/NDP = New Growth Path/ National Development Plan

With Ingula, industrial issues do not appear particularly problematic; instead, a capability asymmetry appears to have been the most significant factor. This permitted principal contractor's claims, to be aggressive and expensive to the project.

- *"The principle contractor employed a full-time specialist agent, to press such claims"* **[IW31]**.
- *"The Eskom claims team were not as 'experienced' as the contractor's; and the contracts were legally weak"*, against Eskom **[IW31]**.

### *5.3 Sere, Avon and Dedisa: the successful*

All three of the counterfactual projects were of a different scale (much smaller) and utilised different technologies to the problematic first group. The technologies used, were ones that delivered active competition between suppliers; had an ability to standardise and modularise equipment and processes, which reduced risk and complexity surrounding each project; and all were less challenging in terms of project capability requirements. All three projects had a principle contractor (as did Ingula) and all three projects were able to utilise a turnkey risk mitigation pricing strategy: that transferred risk from the client to the agent (contractor) [Gregory & Sovacool, 2019a:150].

In response to the fieldwork's second research question, the following were established. Accurate forecasts were used (within a planned margin of error); successful complexity reduction strategies were applied; and stakeholders and their agents had aligned objectives **[IW10**; **IW12**; **IW14**; **IW20**; **IW21**; **IW25]**.

# 6. Big is fragile

> *"Theories of 'big' have advocated the proposition that 'bigger is better' since the mid-nineteenth century, drawing especially on notions of economies of scale and scope, natural monopoly, or pre-emptive capacity building* [Ansar et al, 2017: 60 – citing: Stigler, 1958; Silberston, 1972; Chandler, 1990; Mill, 1848; Mosca, 2008; Porter 1980].

Recognising the above perception, before concluding this study, the literature is reviewed again to contrast the notions of 'big is better' [Ansar & Flyvbjerg, 2016], against 'big is fragile' [Ansar et al., 2017]: for the pertinence of the latter over the former in the context of the RSA and SSA, where the pursuit of policy robustness is usually an observable policy desire. From this review, eight factors were identified that favour greater size causing fragility over robustness in this research context. Broad and deep complexity; a lack in depth of suitable capabilities; socio-political legacy's impact on skills; neo-patrimonialism through state capture; a lack of modularisation; substandard contractor lock-in; systemic asset fragility; difficulty for financing.

## *6.1 Broad and deep complexity*

In Section 2.1, which defines a megaproject in SSA, it did not deal with sub-categories of megaprojects. This will now be briefly examined further, focusing on complexity in both depth and in breadth [Wang & von Tunzelmann, 2000].

The perspective here asserts that a road megaproject is very different to a 'super-critical' coal-fired electricity generation megaproject, even though both types of megaproject can have stakeholder complexity and substantial scale and value surrounding their development. This is because of what Wang & von Tunzelmann [2000] describe as complexity in breadth and depth: where breadth concerns "*the degree of heterogeneity and depth with the level of sophistication"* [Ibid: 806]. An electricity generation asset can be thought of as a large capital good: which is both a complex product and system [Hobday et al., 2000]. The construction of large capital goods involves complexity in their application of technology as well its number of integrated and dependent sub-systems. Hobday et al. [2000], describe these as complex products and systems (CoPS).

CoPS projects are particularly vulnerable to non-linear error growth described in Section 2.2.2 and require broad engineering and project management capabilities for

successful delivery. Scale and scope are consequentially significant to successful execution of this type of megaproject: but the appropriate capabilities in the sub-Saharan region are not plentiful, as will now be discussed in Section 6.2.

## *6.2 Lack in depth of suitable capabilities*

Project capabilities encapsulate contextually appropriate organisational factors that deliver project efficiency (reducing costs or adding value to project outcomes), whilst delivering that value to the project's sponsor [Nightingale et al., 2015:223]. When overlaying the impact of complexity that arises from an increase in scale and scope (discussed throughout), it is implicit that as the scale of a project increases, successful delivery requires more project capability capacity. Further, it can also be deduced that due to the temporary nature of megaprojects, such capacity will deteriorate (or depart the country) if unused for any length of time.

Due to the temporary nature of megaprojects and their sporadic use in the RSA and SSA generally; the use of scale to deliver infrastructure should be very cautiously embarked upon due to a specific lack of relevant capabilities [IW16; IW27]. An NPC[45] commissioner [IW27] mentioned this as a principle reason the NPC "*does not recommend the use of megaprojects in the RSA"* (to be fair, the creation of the NPC occurred after the commencement of Medupi and Kusile).

## *6.3 Socio-political legacy's impact on skills*

Building on Hirschman's African observations discussed in Section 2.1 [Hirschman, 1967], there is an unexplored issue thus far hindering skill transference in the RSA (and SSA generally). It is accepted that when the colonial powers divided Africa up in the 19th century, creating the 50 countries that now form the SSA region, they gave little thought to the socio-political structures that existed on the continent beforehand. Hirschman suggests that these socio-political structures still have significance in Africa when developing projects, as he identified that the socio-political dynamic could be very problematic to such development – and many of the fieldwork interviewees have concurred [IW1; IW3; IW4; IW7; IW11; IW16; IW18; IW19; IW22; IW23].

[45] NPC – National Planning Commission, established in the RSA in 2010

This socio-political dynamic hinders skills transference on a couple of levels. Firstly, it makes sharing skills, through training, more difficult to attain, as training is best achieved within a tribal identity: which consequentially limits training capacity, particularly over rushed timeframes. Secondly, it makes it more difficult to transfer skilled personnel from 'out-of-area' tribal groups, to fill a capacity need elsewhere.

As Medupi and Kusile are in two different tribal contexts: both skill development and skill transfer were always going to be difficult; and this is a problem that could and should have been anticipated [IW1; IW3; IW4; IW7; IW11; IW16; IW18; IW19; IW22; IW23]. Further, the larger a project becomes, the more difficult it becomes to find enough skilled personnel from the relevant tribal grouping: making the project more fragile, as the option of transferring people from elsewhere in the country or further locations, is not a effortless alternative.

## *6.4 Neo-patrimonialism through state capture*

Neo-patrimonialism [Erdmann & Engel, 2006] through 'state capture' describes a category of financial appropriation, that can be observed throughout sub-Saharan Africa, and has recently had a high profile in the RSA (described in Section 4.2.3) [Godinho & Hermanus, 2018]. It depicts a political misuse that is systemic and utilises embedded networks of power and influence: where both public and private actors collude to co-opt the mechanisms of state for their own economic joint benefit [Godinho & Hermanus, 2018; Madonsela, 2019]. This defrauds the normal social contract and the wider societal interests [Ibid]. The value appropriated is used to reward political supporters, to maintain control of the political authority that has been captured [Erdmann & Engel, 2006].

The vast procurement process surrounding megaprojects represent a useful setting to appropriate such value [Godinho & Hermanus, 2018]. As megaprojects involve considerable value and are atypical in the RSA and SSA, it should not be a surprise that they are vulnerable to pressures of neo-patrimonial behaviour, when they occur. The bigger the project, the greater the value that can be misused, which is discussed in section 5.2.3 of this chapter.

## *6.5 Lack of modularisation*

According to Ansar & Flyvbjerg, [2016:36] *"big is not scalable .... but modular is"*.

Many of the interviewees suggested that the notion of 'big is better' described at the beginning of this section, was ensconced in both the upper echelons of Eskom and the RSA government during planning [IW3; IW13; IW16; IW18; IW23; IW24; IW29]. It is accepted that scale can give some types of economies to projects: such as through civil works construction, where volume discounts on orders can reduce unit prices (e.g. concrete); or replicating a proven design and processes in multiple locations (modulation), utilising the tacit knowledge created on the first project by reapplying it. However, the theory behind *economies of scale* was not meant to be applied to novel megaprojects or projects only built in tandem. It is true that with firms, increasing scale can be economical [Chandler, 1990], but a unique megaproject, does not have the features that Chandler is attributing this phenomena to.

> An 'economy of scale' exists where *"producing two or more of something can be done at a lower cost than producing them separately* {…} This principle is then applied to high fixed cost production, spreading the large cost over many units, delivering a low individual unit cost [Nightingale et al., 2015: 217 & 219].

This value saving through volume concept, usually requires standardisation and repetition; as well as a high fixed cost proportionate to variable costs. As discussed in Section 5.2.2.1, Medupi and Kusile are of an atypical design and built in tandem, rendering standardisation and modulation difficult to achieve. It was believed by Eskom, that the separation of each plant into six separate generation units, would deliver modulation economies [IW24] – but the reality, as can be seen from the research data, has disappointed. However, modularisation was successfully used with the three smaller, counter-factual projects [IW21, IW25].

## *6.6 Substandard contractor 'lock-in'*

During the data collection, a question kept arising that demanded an answer: if Hitachi Power Africa (HPA) did not demonstrate the required capabilities to deliver supercritical boilers, why were they not removed as a supplier when that reality became evident? Interviewee IW24 offered the following in explanation for why not, which I paraphrase.

> The Eskom Board discussed with various General Managers whether to terminate Hitachi from the projects, when their lack of competency became evident, but decided against it. There were two principal reasons why IW24 believed the Board

persevered. It would be too expensive to remove them due to contractual termination costs; and secondly, the further costs of time required to get another contractor up to speed to then complete both Medupi and Kusile. IW24 understood that instead, Mitsubishi-Hitachi Power SA (as HPA later became) received incentive payments in March/April 2018 for the acceleration of deliverables, which were already very late. The logic behind the incentives was that all available penalties and LDs[46] had already been imposed: so, Mitsubishi-Hitachi Power SA were in a serious cash-constrained position and pulling bonds/guarantees could have tipped them into total insolvency and liquidation. Rewarding bad behaviour was cheaper than penalising it.

Even though the circumstances described are anecdotal, it does demonstrate a very clear problem for megaprojects that exist within a challenging development environment: such as the one just described, when there may be limited interest from commercial EPC[47] firms delivering large value complex project. A failing contractor may not be easy to replace, and greater damage and cost may be incurred, by doing so. This was also touched upon in Section 5.2.3 when the impact of labour issues reached beyond the removal of a failed contractor. In less challenging environments, this may be managed by getting a turnkey contract, where the contractor manages the uncertainties and underwrites the risk; in SSA, these are less obtainable as the scale of a project increases, due to the perception of increased regional systemic risks (see Section 5.2.2.1) [Gregory & Sovacool, 2019a].

## *6.7 Systemic asset fragility*

Due to co-dependencies, a mistake or error within a complex system, will impact the entire system. Consequentially, such systems can only be as robust as their weakest parts: making them systemically vulnerable [Ansar & Flyvbjerg, 2016]. When compounding this reality with non-linear error growth, which is equally applicable after an asset is built as it is during construction: a single event can destroy the viability of the entire asset, as witnessed by the Chernobyl and Fukushima disasters. The larger the value of an asset that comes with scale, both the greater the potential loss from a single issue; and the greater

[46] LDs – Liquidation damages
[47] Engineering Procurement Construction

the difficulty to ensure a minimal level of quality throughout the entire asset, as an increase scale increases the number of potential catastrophic vulnerabilities.

### *6.8 Difficulty for financing*

Dixit & Pindyck [1994], suggest that an investment can be defined as the act of incurring an immediate cost (the cost of the investment) in the expectation of future rewards (the investment return). By unpacking this definition: an investment can be seen to contain two related but separate parts; and that investors will require a certainty of outcome for both an asset's construction and performance once commissioned, before a commitment to finance can proceed - investment evaluation is a fragile process [Gregory & Sovacool, 2019b:346].

Applying this investment perspective to a CoPS megaproject development in the RSA, suggests that such projects must be challenging to finance. Their long planning and construction horizons, their project specific complexity and problematic nature – acts as a repellent for investors, as this creates significant uncertainty to both parts of the investment process described above, which require certainty. Further, a CoPS megaproject's proclivity for non-linear error growth when trying to correct any mistakes, just compounds investment paranoia. Implicitly, an increase in the scale and the scope-novelty of electricity generation infrastructure will always disproportionally increase the level risk surrounding development cost and timelines in the mind of investors: destabilising the investment case [Gregory & Sovacool, 2019a].

## 7. Conclusion

From the performance outcomes of the various electricity generation projects, derived from the evidence supplied by the fieldwork, it appears that the more substantial and unique that an electricity generation asset's design embraces, the more problematic it will be to produce in a SSA context. Further, in the absence of appropriate engineering and project management capabilities, which is customary in the sub-Saharan region, cost overruns and completion delays are inevitable; in the case of megaprojects, financial collapse is likely to follow. Therefore, when developing electricity generation infrastructure in the SSA region, a measured approach to scale is a necessity, proven

designs are essential; if scale is desired, it must be achievable using modular and familiar technologies.

Being specific to the three problematic case studies and the lessons they can teach policymakers. The central problem for both Medupi and Kusile has been a poor appreciation of the issues of both complexity management and novelty; and how to avoid building it into a project's execution process. It appears Eskom, and probably the RSA government as well, were overly confident in their abilities to deliver the scale and scope of the assets that they had proposed to construct. It can also be argued that they had no comprehension of how important it was, to reduce the complexity of the project and the novelty of technology issues when designing and organising the construction process of both projects. Some criticism probably should also fall on the World Bank here too, as it could have insisted on a standardised design, on a smaller scale, before agreeing to finance the construction of Medupi. Ingula appears less problematic, as the major construction was in effect underground civil works, the capabilities for which were widely available due to the country's existing, experienced underground mining industry.

As a final point of emphasis, when constructing a large complex project with multiple sub-systems (such as an electricity generation asset), it is necessary to focus on how to deliver this asset as specified, as simply and inexpensively as possible. The construction of such a class of asset is not an effective way of increasing the depth of capabilities in a country. Even if some capabilities are initially created or enhanced, unless those skills are continually employed by building more projects of a similar type, those skills will either leave the country or waste away.

## *Policy 'takeaways'*

Projects are temporary organisational structures with an aspiration and purpose, which involve processes that take ideas and transform them into outcomes, whilst influencing the surrounding eco-system that they are positioned within [Nightingale et al., 2015:229]. Moving beyond the theory, however, for sub-Saharan Africa: projects are also expected to be key drivers for the successful delivery of economic development and a conduit for the diffusion of innovation within the region, as infrastructure development is essentially a diffusion of technology through projects. Although megaprojects are not yet common in SSA, this is likely to change sooner rather than later, due to the UNs projected population growth for the region. Therefore, the contextual knowledge of *cause and effect*

surrounding megaproject failure needs to be understood by all policymakers throughout the larger sub-Saharan territory.

Applying this reality to SSA electricity network expansion, it follows that successful development depends on an understanding of how to execute such expansion as robustly as possible. To this end, the study makes the following recommendations to SSA policymakers and planners. First, be considered when specifying the level of scale for electricity generation project development, as big is fragile in any context and arguably more so in SSA. Second, do not rush a project's planning and pre-engineering, as it is a false economy. Rushed planning most likely will lead to disproportionate delays later (greater than the original time saved) and will result in considerably inflated project costs. Third, develop the depth of the country's relevant project capabilities before embarking with complex projects, as such depth of knowledge and skill is necessary to help ensure successful project delivery. Finally, while recognising the dangers of homogenisation when discussing pan-regional solutions for SSA (as each of the region's countries has its own unique socio-political contexts), it is reasonable to build understanding of common difficulties encountered in project and megaproject developments.

# Chapter 6:

# *Discussion & Conclusions*

As I touched on in my introduction to this thesis, there has been a major multilateral policy failure for over two decades, for resolving electricity poverty in sub-Saharan Africa. It has been my ambition behind this PhD's research, to understand why this is occurring and to make a meaningful contribution towards its resolution.

With this ambition in mind, this chapter will now explain why I believe the multilateral development community should persist with this development policy, despite its ongoing failure. I will then revisit and apply the structural problems that we identified in the sub-Saharan region from my second co-authored paper (chapter four), that make it difficult to attract private financing of electricity infrastructure in my research region. This will then be followed by my key findings that explain why the private sector themselves are not willing to invest, including clarifications about these findings and a short review of an analogy. Next, I carry out a policy discussion with recommendations. Finally, I will finish my thesis with some concluding remarks about why I have treated SSA as a homogenised entity in much of this thesis; and why I have not sourced any of my data regarding my research problem, from the investors themselves.

# 1. Why the multilateral development community needs to persevere with its policy for resolving electricity poverty in SSA

Before explaining why this policy failure requires perseverance, rather than abandoning, I will first discuss in Section 1.1 why access to affordable and reliable electricity services is crucial for a country's economic development. Although I touched on this in the introduction of my thesis (Chapter 1, Sections 1.2 & 1.3), that explanation was very narrow, and would benefit from some further theoretical support. Next, in Section 1.2, I then briefly analyse the problematic nature of the strongest alternative source of financing to private investors: The Peoples Republic of China (PRC). In Section 1.3, I briefly summarise the failures of another multilateral development policy that has relevance to electricity access in SSA, Official Development Assistance (ODA), which has lacked success over an even longer period of time. Only then, in Section 1.4, do I then summarise the two principle reasons to persevere.

## *1.1 Why access to affordable and reliable electricity services is so important for economic convergence or catch-up for Africa.*

Access to affordable and reliable electricity is arguably the most important factor preventing meaningful economic growth in SSA. This is not to suggest that there are no other important factors that are holding back growth in the region, such as the existence of 'functional states' run by competent politicians and bureaucrats [Fukuyama, 2011]; or 'the supremacy of the rule of law', which treats everyone as equal rather than favouring those that control the instruments of state [Ibid]; or the existence of 'mechanisms of accountability', which ensures that power is applied in the interest of society rather than specific interests [Ibid]; or that a nation's institutions need to be inclusive and serve the interests of the majority of citizens, rather than exclusive, where they only represent the interests of the ruling elite [Acemoglu and Robinson, 2012]. It is just that even if these conditions are in place, there is still at least one further strong argument to suggest that the sub-Saharan region will not be able to fulfill its economic potential, until it has access to affordable and reliable electricity services.

In the introduction of this thesis, I focussed on the importance of electricity as a General-Purpose Technology: when I briefly described how electricity is an important enabling variable for economic growth. Without discounting the relevance of that

theoretical explanation, I will now build on this attribute of electricity services, by focusing on how electricity access also has a legitimate and vital contribution for facilitating economic convergence, by explaining how it acts as a further social capability to the five identified by Moses Abramovitz [1986].

Convergence theory suggests that over time the knowledge of what is economically successful, will both diffuse to all lesser industrialised countries, in a manner that permits those countries to utilise that knowledge to improve their own economic performance; and that the process of technology diffusion will be faster than the industrial leaders new technology creation [Fagerberg & Srholec, 2008]. The less industrialised country will achieve this by either: imitating, adopting (licencing), or receiving 'best-practice' technologies through foreign direct investment (FDI) [Ibid]. However, as convergence theory can regularly be observed as not occurring in practice, there must be other factors that are required, other than just knowledge [Ibid]. Moses Abramovitz [1986] identified five enabling social capabilities as the required factors [Ibid] – I am now advocating that access to affordable and accessible electricity, should also be added to this list of social capabilities (maybe just in SSA).

Abramovitz's original list of Social Capabilities [1986; 1994a; 1994b] included the following five factors. 1) Technical competence, the ability to use and understand technology: enabled through education of a country's workforce. 2) Experience in the organisation and management of large-scale enterprises: which would include projects as well as institutions and corporations. 3) Honesty and trust must be a societal default: to avoid powerful interests monopolising the interest of the greater society, which would include a proficient legal system. 4) Access to financial institutions: for mobilising the necessary capital and investment, to pay for the necessary application of technology. 5) A stable and effective government: to create and uphold a supportive governance framework. To this list, I am advocating that there is a need to include access to affordable and reliable electricity services as a further factor required to enable economic convergence. I suspect that electricity services did not make Abramovitz's original list, as he was focussing on different geographic areas that had greater levels of electricity access than SSA when he wrote on the subject.

Kim [1997] observes, using evidence from South Korea's successful convergence, that the catch-up process for less industrialised countries is a reversal of the normal innovation process. Usually with a new technology, it progresses through a three staged

development trajectory: firstly the technology emerges, where the market engages with it and starts to integrate it; secondly, the technology then consolidates (which can require complimentary assets [Teece, 1986]), where the market experiments with the technology to appreciate how useful it is, and it diffuses throughout an economy as actors embrace it; thirdly, it then matures, as it settles into the economic landscape and becomes a standard, familiar and an assimilated technology [Ibid]. When a country is catching-up however, and adopting existing technologies from industrialised contexts, there is already a proven path dependent trajectory for that technologies adoption: as the technology is already understood and appreciated in its original industrialised context. Consequentially, as industrialised economies are ecosystems where access to affordable and reliable electricity is an accepted reality – their technologies can also be assumed to require an access to electricity too for their efficient diffusion. For a country to successfully assimilate any types of innovation, that country will therefore require access to affordable and reliable electricity.

## *1.2 Financing from the PRC*

Financing from the PRC can be regarded as fulfilling a similar function to that of other forms of private financing of infrastructure. It is an enabling variable for building infrastructure which occurs because the sponsor of the investment is expecting a *future reward* in return for their financial input (see Chapter 2) [Cheung et al., 2018; Donou-Adonsou & Lim, 2018]. Where it differs from other forms of overseas sourced private investment, is that it utilises a different type business model. A business model that monetises some of the externality benefits that are available from such types of investment, which are not perceived to be valuable to a typical overseas private investor.

'Greater China' acts as the sponsor (which can be viewed as a combined investment system), who is prepared to monetise the strategic externality values that investment in Africa offers as a whole (such as access to commodities and geo-political influence). Further, the country also coordinates their lending as part of a larger EPC package, which focuses on capturing the engineering, procurement and construction value for China (both technology and labour) that arises from any investment [Donou-Adonsou & Lim, 2018; French, 2024]. The country is creating economic output for themselves, by recycling their excess capital, which currently would create little return if it were invested in a traditional manner such as US bonds [Donou-Adonsou & Lim, 2018; French, 2024].

The commencement of the recent trend of Chinese investment in Africa, can arguably be traced back to the visit of the Chinese president Jiang Zemin in 1996 [Alden, 2005; Donou-Adonsou & Lim, 2018], which can be seen as a very early act of China's 'Step-out Policy', which became formalised in 2000. His visit came just two years after China had created two policy banks, The China Exim Bank and The Chinese Development Bank, whose creation was designed to act as a vector for advancing Chinese overseas investment and development [Gu & Carey, 2019]. Both banks report directly to the State Council (the effective cabinet of the PRC), and are financed by ad-hoc capital injections from the national budget: which provides policy flexibility [Ibid]. Their principle function is to act as lenders of **first** resort for infrastructure and other development, in regions of strategic interest to China. The Chinese strategic goal is to provide integrated investment packages in coordination with the country's construction industry, designed to cut time frames and work with deficient management capabilities of recipients (types of risk reduction measures as discussed in Chapter 3) [Ibid].

China's engagement with Africa has been further reinforced 2013, by President Xi Jinping's new Belt and Road Initiative (BRI). The vision behind the BRI, is to use the growing Chinese economic muscle, substantial surplus capital, proven engineering and project management capacities: to become a transformative actor and secure strategic benefit and influence [French, 2015; Gu & Carey, 2019] – a formalising of the earlier described approach. China had surpassed Japan in the second quarter of 2010, to become the second largest global economy [Bloomberg 2]; and was starting to project the influence and the status that comes with such economic significance.

According to Howard French's book 'China's Second Continent' [2014] however, this engagement is becoming problematic for its recipients. Firstly, its strategy has utilised substantial Chinese migration into the region (over a million Chinese nationals now live in SSA), the assimilation and engagement of which is causing many problems, as most of these migrants appear uninterested in the local African cultures. Secondly, the African's believe that the Chinese do not employ the local African people; and if their businesses do, they pay significantly less than they would to Chinese expatriates. Thirdly, there is a feeling of déjà vu amongst the recipient populations, as both resources and profits do not remain in the region but are expatriated back to China for the benefit of that country's economy. Fourthly, corruption and backroom deals with ruling elites, only permits a minimal trickle-down effect to the country's disadvantaged populations.

Even allowing for a level of contestability in French's described perspective, and proportionally discounting his narrative, it still suggests an exploitive policy, where an inclusive one would be a preferable form of engagement.

## *1.3 Financing through ODA*

As I alluded to in my introduction to my first co-published paper in chapter 3, Official Development Assistance (ODA) has existed since at least the early 1970s: when it was devised and named in 1969, and then finalised in 1972[48] [oecd.org]. ODA has also failed as a policy to resolve African electricity poverty and represents a public sector policy narrative that has been in existence for almost 50 years. Accepting that it is a general global development policy for all developing economies, I draw attention to it, hoping that its longer duration as an unsuccessful public sector approach, will make my defence of a privately sourced one a little easier 'in the eyes of' those less ideologically supportive of such narratives.

## *1.4 The two principal reasons for persevering with the current policy*

**Firstly,** I believe that the policy of promoting the private financing of electricity infrastructure development in SSA needs persevering with, as there is no realistic alternative for resolving my research problem in that region. I have already explained that a public sector approach, in the form of ODA, has failed despite a far longer history. More significantly however, is that for the level of funding required for the adequate electrification in SSA, only the private sector can deliver that level of resource – referencing again, the following evidence from the IEA:

> *"The amount of investment needed for the provision of electricity in sub-Saharan Africa is substantial and well above the level of the current flows of capital into the region's power sector. Reaching full access by 2030 and maintaining it to 2040 would require multiplying current investment levels by five. The cumulative investment in this case would reach more than* ***$2 trillion between 2019 and 2040****"* [IEA, 2019:141].

So, policy agents need to consider where else might $2 trillion be sourced from, in a politically acceptable way for all the DAC country's electorates? This is a legitimate notion, as there has been a failure of the DAC members to contribute .7% of their

[48] By the Development Assistance Committee (DAC) of the OECD

GDP as ODA: an agreed strategy for ODA dating back to when the policy was designed – with the USA being the most notable transgressor [oecd.org].

**Secondly**, any policy consensus required between many stakeholders who have different 'masters' (which is what the multilateral development community represents), are always the most complex to reach a consensus between [Howlett et al, 2009]. It will either be very difficult to achieve an agreement over what the replacement policy should be; or an attempted reform of the policy to deliver a different outcome, will be vulnerable to the inefficiencies caused by either layering or drift [Ibid:204]. Layering being where a new policy priority is overlaid on the previous one(s), rather than removing and replacing the original policy aims; drift is where a policy's aim(s) is redefined with no redefining of the tools to achieve them.

As will be observed later in this chapter, I will instead be discussing forms of policy conversion: where I examine possible reforms of the tools and inputs of the policy process, but not the policy goals [Ibid]

## 2. Structural factors, working against the policy

In my second co-published paper's discussion section (chapter 4, sec.6), we synthesized 15 structural factors that require appreciation by policy actors as currently preventing private investment in SSA electricity infrastructure – the key thrust of the multilateral policy I am now defending. Before moving onto my key findings of my thesis in my next section therefore, which will focus on the perspective of private investors, I will revisit and explain how these structural factors have relevance to my key findings and policy recommendations.

1. ***Insufficient local banking capabilities.*** *In most SSA countries, the domestic banking systems are unable to finance any significant value of electricity infrastructure projects, even at a household level*.

   The stressing of this structural factor represents an implied call for the policy community to embrace international private investment, as a legitimate part of a solution to resolving SSA electricity poverty (as I believe many are reluctant to do). Foreign (out of region) investor involvement shouldn't just be criticised as being

exploitive; instead, it should be recognised as a legitimate and necessary part of a solution, that requires careful management to ensure maximum positive impact.

2. ***Exchange rate convertibility****: the inability to repatriate the principal investment and the investment's returns, into the foreign investor's original currency – usually attributable to either exchange controls or insufficient African currency liquidity.*

   This structural factor is analysed in detail in my key **finding VII**, in the next section.

3. ***Uncommercial tariff regulation****: electricity tariffs are not permitted to be commercially reflective of their cost of the investment.*

   Private financing can potentially only occur using project financing, which relies on the creation of bankable cashflows (**findings IV**). This is only possible to create, if a predetermined tariff that is commercially reflective. A continuance of setting uncommercial reflective tariffs, will assure further policy difficulties.

4. ***Inadequate law and order structures.*** *In many SSA countries, the institutions of legal enforcement do not prevent theft of various forms of value from an investment, as there is no effective recourse, or they represent the actual perpetrators.*

   Anything that removes any anticipated value of an investment, is troublesome to the ability to attract it in the first place. This is reflective of the 'hold-up problem, which is explained in my **finding V,** as **market failure two**.

5. ***Uncertain security of the physical asset****. When there is a notable probability that the value of the investment will be diminished or destroyed by an independent third party's action, such as theft, vandalism, or terrorism.*

   Ditto – structural factor 4.

6. ***Uncertain revenue security of the asset****. When there is a notable probability that an unrelated third party will unexpectedly misappropriate the anticipated revenues (or a percentage of them) from the investment.*

   Ditto – structural factors 4 & 5.

7. ***Unearned equity dilution****. When there is a requirement to allocate significant percentage of ownership (equity) of an investment, in return for nothing other than a permission to proceed.*

This structural factor does not remove value unexpectedly, but it does make the maths behind an investment, less compelling – adding to investment inertia described in my key **finding I**.

8. ***Rent-seeking****: the attempt to appropriate excess value or 'rent' from an investment where such rent value does not exist, by non-related beneficiaries of the investment.*

   Ditto – structural factors 4, 5 & 6.

9. ***Corruption by officials****: the abuse of a power asymmetry, in return for non-obligatory financial gain.*

   Ditto – Structural factors 4, 5, 6 & 8

10. ***Patrimonialism****: the transference of value to an unrelated party (an insider) to support a political patronage system.*

    This is a very similar point to my structural factor 7, as are its impacts.

11. ***Reallocation of the ownership of a project****: a project's ownership can unexpectedly be removed and reallocated to an unrelated party (usually between the planning and construction phases). This means an instant loss on all preparation costs up to that point by an investor.*

    Like structural factor four, this is again a form of hold-up problem, which is explained in my **finding V**, as **market failure two**.

12. ***Path dependency and regime resistance****: the government or the monopolist utility are locked into a technology paradigm, which makes them hostile to change.*

    This concerns my key **finding VI**. If the electricity service delivery system is not operating efficiently, it is likely to suffer from diseconomies of scale: as it will likely be charging less for its electricity sold, than it costs to produce and deliver it.

13. ***Insufficient working capital****: there is insufficient working capital available within the utility, to support, operate and maintain the technological system at efficient levels.*

    Ditto – structural factor 12.

14. ***A lack of complementary assets****: the supplementary assets or capabilities that are required to allow the primary asset to operate optimally are not available.*

    Ditto – structural factors 12 & 13.

15. ***Deficient technological tacit knowledge and skills***. *The successful diffusion of different electricity technologies are impeded by a shortfall of institutional and individual's technology-orientated capabilities.*

    This primarily influences three of my key findings: **findings III, IV and VI** – but I could equally argue that this structural factor is much broader and touches all my findings to some degree.

# 3. My key findings

Reflecting my list of fifteen structural factors and other conclusions that can be drawn from my research, the following are my eight principle findings that explain what is deterring private investors from financing large-scale electricity network infrastructure in sub-Saharan Africa.

## *3.1 Results:*

I. ***There is no singular reason for explaining a lack of enthusiasm by private investors: instead, the reasons are multiplicitous and mirror some of the principles of inertia.*** (Chapter three, sec.4.&.5)

   There is no single explanation for why private investors are not investing in SSA electricity infrastructure, other than all the identifiable variables are forms of investment risk. These risks are difficult to quantify, mitigate or manage in my research context: and they display cumulative characteristics that lead to a type of inertia. The more the risks accumulate, the more investment inertia builds to undermine the likelihood of investment success: until it reaches a *tipping-point*, where all investment interest disappears.

II. ***The ability to finance privately the development of electricity infrastructure in SSA is a dependent variable.*** (Chapter one, sec.2.4 - chapter three, sec.4.&.5)

   I believe I have confirmed my hypothesis: that the ability to finance electricity infrastructure development privately in SSA is a dependent variable, which is influenced by many independent variables or risks. However, these risks surround two different facets to my original hypothesis: **firstly**, they control how much the infrastructure will cost to build, which is difficult to predict and expensive when

it goes wrong. **Secondly**, they determine how reliably an investor can receive their investment rewards and the return of their initial cost: their reasons for investing.

### III. *It is difficult to predetermine the full cost of constructing electricity infrastructure, within an acceptable value range – particularly when the scale and scope of an infrastructure project increases substantially.*

The ability to know the full cost of an investment is crucial to determining whether to proceed with that investment (as a private investor). Referring back to my conceptual framework explained in chapter two, section 4 (and reiterated in chapter four, sec.2.2) – a decision to invest has two parts: an initial cost is incurred; and a level of reward for investing is expected, in response to that initial cost (which must increase if the cost increases). Therefore, understanding exactly how much it will cost to construct an asset, so that it properly functions to enable it to make the returns anticipated by an investor, is an absolutely priority for the investor.

In SSA, much of this cost uncertainty is due to issues surrounding capabilities and policy decisions: which makes it difficult to quantify the full cost of planning a project, and then constructing it on budget (chapter three & four). This uncertainty is then likely to dramatically increase as the scale of the proposed infrastructure is increased: as a linear increase in scale and scope, exponentially increases the development complexity – and is therefore likely to increase any costs in an accelerating manner (Chapter five, Section 2.2 & 6).

### IV. *It is very difficult to create pre-determined, reliable, and long-durational cashflows, which can match the duration of the infrastructure investment.* (Chapter 1, sec.6 & Chapter 4, sec.4&5)

The standard method the private sector uses to finance infrastructure, is termed project financing – where a project's cash flows are pre-determined and then protected or guaranteed in some way: allowing the cashflow to be attributed a net present value or NPV. Finance is advanceable against this NPV figure. The longer the duration, the greater the value created. Such a cashflow in this context is derived from an electricity offtake agreement[49]: known as a Power Purchase Agreement (PPA).

[49] Electricity Offtake Agreements: an agreement to purchase a set amount of electricity for a pre-agreed price and length of time. This permits a definable value of cashflow to be created (an NPV), which can be invested against (it represents a form of risk management, through risk transference).

Actions of the inefficient and dysfunctional utility and/or associated government institutions within SSA, such as regulators or relevant government ministries, usually impede the formation of the acceptable cashflows required to create bankable PPAs.

## The market-breakdowns

The balance of my findings now consists of what I am identifying as several types of market-breakdowns. I am using this idiom to describe two types of problem: firstly, circumstances where the *natural stabilisers* prescribed to market forces, do not appear to function; secondly, techniques that are available in a OECD context are for various reasons not available in SSA. I am not using the more traditional term of market-failures, as some of these factors are outside the tight academic use of this term by economists.

### V. ***Traditional financing risk mitigation techniques are problematical in SSA: due to several different types of market-breakdowns.*** (Chapter 2, sec.1)

I have initially grouped some of my identified market-breakdowns, as my first four describe how some of the standard risk management techniques that can be applied within an OECD context, are difficult to use in SSA – which in turn prevent investment opportunities from qualifying as bankable, eliminating investor interest.

- **Market-breakdown one**. *The adverse selection problem: the existence of knowledge asymmetries between investors and possible investment recipients*. (Chapter 2, sec.1; Chapter 6, sec.3)

  Adverse selection problems occur, as the recipient of the value of an investment (or insider) is better informed about the risk dynamics surrounding the investment than the potential investor (or outsider) – their perceptions of value and risks surrounding the opportunity are different [Deb et al, 2011]. This asymmetry undermines an investor's ability evaluate an investment's risk and causes potential investors to be overcautious in their risk assessment (their risk weighting valuation, discounts too much value): this is *The Lemons Problem* [Akerlof, 1970]. This problem makes it harder to attribute greater value to what are the better projects *ex-ante*, which discourages their creation, thereby reducing the perceived quality of all of that class of project.

Traditionally, the entity seeking investment might offer warranties: but these need to be believable and enforceable. In an OECD context, reliable and independent credit ratings agencies supply knowledge surrounding 'reputation and creditworthiness' to manage *The Adverse Selection Problem* (see sec.2.3 of this chapter). However, the three recognised credit ratings agencies (Standard & Poor's Investor Services, Moody's Investor Services, and Fitch Ratings) do not offer this kind of knowledge analysis surrounding SSA infrastructure. They are private organisations, whose business models are decided by commercial imperatives [Deb et al, 2011]: and this represents a profile of opportunity that is disinteresting to them currently[50].

- **Market-breakdown two**. *Hold-up problems: a consequence of the permanence and illiquidity of infrastructure. (Chapter 2, sec.4.2)*

  Infrastructure investment represents a sunken cost once it commences; or to use a different positional explanation: it is irreversible once it has occurred. Due to this dynamic, private investors are vulnerable to *ex-post* exploitation or interference, making investors hesitant to commence with such types of investment until they can be sure that the asset will perform as expected (cost and revenue), and this hesitancy is compounded further by the long investment timeframes that the maths behind infrastructure investment demands. This is a type of *Hold-up* problem, as described in 'Game Theory': and represents a form of market-breakdown [Ellingsen & Johannesson, 2004].

- **Market-breakdown three**. A*n inability to mitigate the risk of initial value loss, through the conduit of surety.* (see Chapter 2 sec.4.3)

  The traditional methods investors normally use to protect the value of their initial investment, which involves a concept of *surety*[51], are not easily useable in SSA. These traditional value protection techniques are as follows:

  - Asset backed lending: where the value of an alternative asset is offered as surety. This is not available, as there are too few assets representing an acceptable transferable value in the region, to act as surety.

[50] Discussion with an employee of Standard and Poor's at a conference

[51] **Surety**: in this context, is where something valuable that is not money, is offered by an investment recipient (the insider) to an investor (the outsider), to help assure the value of the initial investment is secure and returnable.

- Balance sheet lending: where another entity guarantees the value or acts as surety. This is not available as there too few entities with acceptable balance sheets in the region, including governments, which are acceptable to act as surety.
- Power Purchase Agreements (PPAs): this is where a necessary surety value is created through an NPV calculation applied to the proposed investment's offtake (electricity sold). There are too few credit-worthy electricity offtake agreements available, to permit successful project financing (see footnote 49).

- **Market-breakdown four**. *Insufficient contextual capabilities are available for the efficient development of new electricity infrastructure.* (Chapter 4, sec.5)

  Capabilities in this context describes, having the ability, knowledge, skill, or the qualities that are necessary to build electricity infrastructure: both organisationally and technically; and possessed both by individuals and institutions.

  Traditionally, such institutional and individual capabilities are developed within firms [Bell & Pavitt, 1993; Scott-Kemmis & Bell, 2010], but throughout SSA there is not a sufficiently well-established industrial base, to develop a 'local' depth of capability that is required in the region to efficiently develop infrastructure of any form. Further, companies do not have the resource to finance the development of such skills, or the required frequency of work to perfect them to suitable levels – to turn codified knowledge into tacit knowledge. (See Chapter 5). Finally, these skills (which once created, are usually possessed by individuals) are then vulnerable to disappear with the person, as such a skilled employee in the region will be in significant demand.

## VI. *Dis-economies of scale: as electricity output capacity increases, so do the inefficiencies of operation and losses.* (Chapter 4, sec.5)

The dysfunctionality of most of the region's electricity delivery systems (the utilities and surrounding government institutions), triggered by the complexity associated with such systems, results in them operating at a loss. Under these circumstances, despite having the highest tariffs in the world for electricity (adjusting for subsidies) [Blimpo & Cosgrove-Davies, 2019], expanding electricity access increases the losses of the electricity delivery system – and would force a utility into bankruptcy if not subsidised.

The domestic politics of the countries concerned make it difficult to differentiate aspects of regulation within the nation's system, such as tariffs; or improve its

efficiency of operation, due to alternative political agendas. This represents a type of market-breakdown.

**VII.** ***It is very difficult to appropriate investment returns into an investor's original currency.*** (Chapter 4, sec.3.5)

In SSA, all currencies are termed 'soft' (excluding SA), meaning they are illiquid and not easily exchangeable in large value transactions. This creates a significant inability to repatriate the immediate cost of an investment and any investment return, back into the original currency of an overseas investor. The inability to repatriate funds by an investor is the ultimate barrier to investment: as this removes both the 'future rewards' of an investment as well as destroying the 'initial value' – the whole *raison d'etre* behind an investment. This is particularly problematic with long-duration investments typical of infrastructure, as this maximises the risks surrounding policy uncertainty and any changes in global investment sentiment.

Currency markets do not function systematically but are instead social constructs, which are market based and order driven. They require large numbers of both buyers and sellers to meet and trade, to permit them to function efficiently [Froot & Stein, 1991]. Systems to help create further efficiencies are employable – but without sufficient originating orders in the form of the buyers and sellers, they cannot function as required by investors.

As most SSA countries have semi-industrial or agrarian based economies, they have not integrated sufficiently with international trade. Therefore, there is insufficient liquidity to create efficient exchange-rate markets. This represents a type of market-breakdown.

**VIII.** ***It is very difficult for a private investor to monetise the value of the externality spillover benefits associated with electricity infrastructure, valuable as they are – and this includes receiving subvention support.*** (Chapter 2, sec.4.6)

I covered in some detail in my introduction, many of the externality spillover benefits deliverable by access to affordable and reliable electricity services – these being the greater benefits to a society and economy, outside the normal linear economic relationship of generating and selling electricity for a profit. Such benefits present a substantial value to both the recipient country and the greater world society.

These spillover benefits, substantial as they are, are also very difficult to appropriate, or internalise (as economists describe it). Externalities as both costs and benefits are shared 'by many', but usually produced by 'the few'. It is therefore difficult in my research context, to compensate a private sector entity for the value of the benefit of the externality, as it is difficult to quantify and legitimise such a form of compensation to those who ultimately transfer the value – in my research context, this is likely to be taxpayers in the form of aid. This represents a type of market-breakdown and a policy-breakdown.

## *3.2 Clarifications surrounding my results*

On their own, none of my key findings is likely to preclude private sector investment, particularly for investors who regard themselves as having African contextual knowledge and expertise. Nevertheless, in combination, they represent cumulative factors that then create investment inertia, making an investment proposition ultimately non-bankable. I also recognise that none of my individual findings is unique in their character, as they are all recognisable in other contexts (often with a descriptive label). What I believe is novel however, is how I have collated them as representing a more suitable explanation for the existence of electricity poverty in SSA; and identifying them as being cumulative and displaying the characteristics of inertia, which create a *tipping-point* in my research setting – that when reached, terminates investor interest.

Despite using a governance lens for my analysis, not all my findings are necessarily governance related, notwithstanding having identified them all just using such a lens. My findings related to capabilities, may also be too narrow. I suspect however, that if I had had the capacity to apply capabilities as a supplementary lens, through asking further research questions with a capability focus in my data collection, I would have further clarified my structural factors that have fed into my key findings, rather than increase the number of key findings in themselves. Most of my capability findings arose out of my data analysis for my third paper, which made up my Chapter 5 of this dissertation. I will revisit capabilities, in my policy discussion in section four.

Different types of **knowledge deficiency** is a continual theme throughout my findings (and my thesis generally). Moreover, this knowledge deficiency is not just apparent in

any particular governance stakeholder group (as identified in chapter 4), but it is multiplicitous. Every stakeholder group within the governance system embraced in my second paper, has important knowledge deficiencies that are leading to my research's identified policy failure. Moreover, each of the stakeholder groups have a different basis for their deficiency – and most importantly, do not appear to prioritise any corrective responses. It also appears to represent a collective action problem [Booth, 2012], another market-breakdown, as individual interests attempt to benefit through the knowledge asymmetry to the detriment of the greater system's mutual interest of cooperation.

Finally, the second half of my findings surround several market-breakdowns: many of which exist because of the semi-industrial (or agrarian focused) structure of most of SSA economies, discussed in my working assumptions at the beginning of my second chapter. This economic reality prevents the *natural stabilisers* of market forces, from functioning. This does have a benefit however, as I can make better informed policy recommendations derived from other contexts, where these types of market-breakdowns have already been found to exist. Because such parallels exist with my research context, this has led me in the next section to examine one historical similarity in particular – surrounding the history of Credit Ratings Agencies (CRA). Regarding other precedents, I will analyse these in my policy discussion (sec.4).

## *3.3 The history of the Credit Rating Agencies: can we learn anything?*

As I discussed in both my introduction to this thesis, and within my fifth key finding, the existence of the CRAs have an ongoing relevance to my thesis subject and research problem. I will now argue, by summarising their history and their function, that their *reason for being* also shares several parallels to my research topic and problem.

The ratings agencies came into existence to resolve a very similar problem to one of my research findings: the existence and resolution of asymmetric knowledge. The CRAs arose to assist dispersed investors in monitoring the risks behind a class of assets (in their case, debt instruments). They evolved to help reduce information asymmetries between investors and borrowers, by removing (or at least reducing) the adverse selection problem that exists between debt issuers and possible investors [Deb et al, 2011]. Over time, the CRAs function has broadened, to assume a form of certification role over the credit quality of the entities they rate.

### What a credit certification represents

A credit rating is an ordinal ranking, of an entity's credit quality, ascribed by a CRA based on informed and fundamental analysis. It represents a pooling or amalgamation of knowledge and cost – to allow a diffusion of knowledge, where it would not commercially occur otherwise: by creating economies of scale. A CRA's ratings, are also forward looking and subjective, reflecting a range of qualitative and quantitative indicators. Ratings are also typically set over the business cycle, where data is statistically averaged. Finally, they are independent, neutral, and objective assessments: without bias towards any stakeholder, which it represents value to [Ibid: 4].

### What benefits are derived from such certification

Certification removes, or at least reduces knowledge asymmetries and improves the agency of both investor and the receiving entity. Furthermore, they encourage investors to participate, where their lack of knowledge would normally deter them from doing so. They do this by creating more efficient investment markets: from an investor's perspective, risk is more easily assessed, priced, and charged; alternatively, from the recipient's perspective, the better the investment proposal formulation, the cheaper will be its funding.

Most importantly, CRAs are neutral. This reduces any participant-induced frictions, encouraging better behaviour. It encourages issuers to be more forthcoming, so their proposals stand out within the greater investment landscape and are therefore more likely to succeed. The credit rating signalling (the positive or negative outlooks) also encourage better behaviour from issuers, for fear of penalties and reduced funding in the future. In conclusion, certification overall improves the depth of capabilities, creates acceptable transparent standards. It also expands investment and creates investment momentum [Ibid].

# 4. Policy discussion

My policy discussion is now going to focus on responding to the last six of my key findings, as my first two were only observations of descriptive features, surrounding my research problem – rather than consequential findings, which are modifiable by a change in the policy framework.

## *4.1 Reducing Scale and scope*

As I explained in Chapter 5, Section 6: contrary to the normalised belief that 'big is better' when developing electricity generation infrastructure in SSA; instead, an increase in both the scale and scope increases the fragility of such a class of development in at least **eight ways**.

1. **Broad and deep complexity**. Large electricity generation development projects are multi-dimensional in their complexity, as they are both complex products and systems. If you increase either their scale or scope, they become more complex in both dimensions: therefore, exponentially more problematic to build on time and budget.
2. **A lack of capabilities.** When either scale and/or scope is increased in an environment that lacks the relevant skills and knowledge (capabilities), it increases the likelihood that the workforce building it will not be suitably skilled to deliver the project. It will also be more difficult to hire in the extra capability required, to handle the complexity, after the project has commenced and the need to avoid delays might be urgent.
3. **Socio-political legacies.** The skill and knowledge deficit just described, is compounded in SAA by socio-political legacies. Members of one tribal group are often reluctant to work effectively with members of other tribes, which compounds the difficulty of either hiring capable staff or training them.
4. **Neo-patrimonialism though state capture.** An increase in both scale and scope intensify both the desire to capture value to support neo-patrimonial tendencies from the political elites that wish to stay in power. This is problematic in two ways: firstly, it increases the negative consequences if such appropriation occurs: as resources will be diverted away from the reasons they were allocated to the project in the first place, creating problems. Secondly, non-linear error growth will create ever more problems when trying to compensate for the original mis-appropriation. Those mis-appropriating funds have either no concept of the problems that they create, or do not care.
5. **Modularisation** helps to manage the complexity that comes with both scale and scope; and should be sought as a design priority.

6. **Substandard lock-in.** As was clearly demonstrated in Chapter 5, the more complex a project becomes, the more costly it becomes to replace a sub-standard contractor. In SSA, projects scale and scope should be restricted to a level that permit contractors to underwrite the value of their work through a commitment to 'turn-key' contracts.

As an undiscussed consequence, that is perhaps worthy of further research, scale and scope increases the need to employ overseas contractors and personnel - which perhaps would be in contradiction of the political priorities of the citizens of the country.

7. **Systemic asset fragility.** Due to co-dependencies in complex projects, assets once built are only as robust as their weakest point. Increasing the scale and scope, increases the likelihood of catastrophic failure, as they both create more potential points of weakness within the system.
8. **Difficulty for financing**. Any asset that is designed to be more problematic, by increasing its scale and scope, will also be more difficult to finance.

As robustness is usually a policy priority amongst policy makers in the region: scale and scope need to be reduced when formulating policy surrounding infrastructure projects. Further, technologies that are granular and repeatable: whose scale can be increased predictably and with transparency, should be encouraged. Wind and solar renewable technologies represent such suitable types of technologies.

## *4.2 Support the creation of long durational cashflows*

This is the reason I embarked on this PhD: I was aware how difficult it is to create long dated cashflows in SSA, which can be repatriated into an original currency of an overseas investor. This is further complicated, as the cash-flow must be a suitable duration for permitting the mechanism of project financing to work (usually more than 20 years). Therefore, my key **finding IV** supports my previously held intuition.

I need to add to this however, building on my **key finding VII**. When unpacking this problem into its constituent elements, it becomes possible to appreciate that this is not just a hindrance associated directly to a utility's (or their relevant government's) credit worthiness or functionality. Instead, it is relatable to the systemic semi-industrial character of most sub-Saharan country's economies, where their lack of integration with the global-trading system and its markets, prevents a liquid and functioning exchange-rate system from developing.

Currently, the only kind of industry in SSA (outside the RSA) that can rely on a reliable hard currency cash-flows, are those industries exporting primary commodities, which deliver a revenue stream in US$: oil from Angola or Nigeria; diamonds from Botswana; cocoa from Ghana would be good illustrations. For international investors: electricity for domestic consumption that receives its revenues in an African based currency, are problematic as an investment proposition.

It may be possible to create new business models, which utilise agriculture to deliver hard currency cash flows. However, agriculture relies on land to farm, which could leave current subsistence farmers dispossessed of their livelihoods. Any solution that was to utilise agriculture to create cash flows, must also be able to compensate the population that would lose out from any land dispossession. I will revisit this issue in my section 5, as it represents a motivation for my new policy perspective for Africa.

## *4.3 Create and expand risk management tools*

As I mentioned in my discussion surrounding my key findings (sec.3.2), the advantage of recognising previously identified market-breakdowns from other contexts in my research setting, is that I can potentially transfer their solutions from those contexts too. Such solutions are now the basis for the following discussions. Before embarking on outlining policy recommendations however, I will first revisit the project management literature to communicate their five standard ways to manage risks: as I believe this will act as a useful point of reference for such discussions.

### 4.3.1 Five ways to manage risk

The **first** method to manage risk is to accept it, if its likelihood of happening and/or its impact if they do occur, are not significant. The **second** method, if the nature of the risk is identifiable, is to avoid it if possible: this might involve a re-design of the process of engagement to involve greater certainty or (as often with an investment), reject an opportunity and move on after little evaluation. This can mean missing good opportunities – and in my research context, it would mean avoiding investments of any sort in Africa. **Thirdly**, risks can be reduced through the accumulation of knowledge: by again avoiding the risk when the acquired knowledge demands rejection; or planning how to manage the risk in advance, through the application of contextual capabilities. Alternatively, the nature of the risk might permit the building of contingencies/redundancies into your

planning or deciding on pre-planned responses (you accept and plan for the risks). **Fourthly**, risks can be transferred to another entity, if there is one that is prepared to accept the risk. Finally, the **fifth** method is to reduce the level of risk by diluting it through diversification: this only works with project specific risks, not systemic risks (and many make the mistake, of not appreciating the difference) [Hillson, 2004]. These risk management responses, will now be applied to my market-breakdowns.

### 4.3.2 Proposed solutions

- **Resolve knowledge asymmetries between the 'outsiders and the insiders'.**

To resolve knowledge asymmetries, I am advocating **the creation of a new institution**: to reduce/remove asymmetric knowledge between investors and the recipients of investment value: both external and internal (risk-management method three). Such an institution would partly function in a similar way to a CRA: in that it would be responsible for collating, amalgamating, analysing, and disseminating information for use by all the interested participants of the SSA infrastructure investment ecosystem – however, it would also be responsible for much more.

For the wider African technical infrastructure ecosystem, this institution would remove knowledge asymmetries, by acting as a repository of sector relevant news and other essential contextual knowledge; it would also rate the reliability and credit worthiness of the regions countries, utilities, industry suppliers, contractors, and any other actors – but through its process of delivering this, ensure there exists a roadmap of best practice' for such actors to aspire to and imitate. Unlike a traditional CRA however, it would also seek to create common organisational standards, processes and documentation and skills; it would also be responsible for training and disseminating the dynamic technical capabilities that Teece et al [1997] (see Chapter 4, sec.5) described as essential for the efficient functionality of such a technical innovation system – which it would deliver to any sub-Saharan country that required such a strengthening of knowledge and skill.

For **potential investors**: it would function in a similar way to a CRA. It would be responsible for building a repository of knowledge of qualitative and quantitative indicators surrounding all likely and relevant risks involved in building any type of infrastructure within the sub-Saharan region. This would involve creating and publishing risk assessments and ratings for individual countries, their relevant institutions, and private enterprises. This knowledge would be of an open access nature and freely

available at no cost. Its dissemination process will prioritise creating transparency and removing knowledge asymmetries.

The existence of such an institution would help resolve a number of the market-breakdowns identified in my **key finding five**. These would include *hold-up problems, adverse selection problems,* and certain policy related technical, financial and project management capability deficiencies.

**How to prevent institutional capture.**

I am sure the need for such an organisation has occurred to others (maybe not with both functions combined), which would support the notion that creating such an institution is likely to be challenging. Certainly, the dominant CRAs following the Global Financial Crisis in 2008/9, have indicated that there is an ample scope for contestations surrounding such organisations: as their decisions can have significant value altering outcomes. With this knowledge, I will therefore apply a political economy lens, to understand the most likely dynamics that would potentially negatively impact my proposal.

The fundamental instability surrounding this sort of organisation, concerns the substantial value altering nature of their decisions; and therefore, how neutrally and objectively they can act in their function as a credit referee when making such decisions: such as when a third party with an agenda is helping to pay the bills? Or to reposition this approach slightly: can their *raison d'etre* be captured and corrupted by interested parties? To answer this problem holistically, I will consequentially unpack the dynamics of influence – who benefits most if credit decisions are changed? And assume that this is most likely to comprise any recipient of the types of value, that can be derived from an investment.

The evidence from the risk challenges that impact the objectivity of the current dominant US based CRAs, concerns how these sort of institution are and have been financed – their business models. If they only charge 'ratings fees from the recipient of their analysis, this might cause the CRA to expend a disproportionate resource on 'chasing new business' rather than accurately keeping their 'published rating' analysis accurate and relevant. There is also likely to be a bias to be generous in the published conclusions of any such analysis towards those that are paying for it [Deb et al, 2011] – which will overtime undermine the organisations reputation and credibility.

A recipient pays model is also problematic in other ways, particularly in the development context of SSA. Firstly, the landscape of investment is already a financially challenged one, as discussed throughout this thesis, so it is unlikely that many of the profiled potential recipients will be able to afford to pay for such a rating – which undermines this proposal's raison d'etre. We also know from my second paper, Chapter 4, that misappropriation is a problem in the region - and as such an institution will be recruiting its human cognitive capital, from the region – so my proposed institution will also be at risk from known cultural factors that will be normalised within its employees.

In a user pays model, the investor that relies on the rating pays for it, which is equally problematic in this region. Initially (and currently) the need for such ratings is not a commercial proposition – there is just too small a financial demand to deliver a revenue, that can create a meaningful and useful institutional capacity (Chapter 2. Sec.1). Further, the role described for this institution is not meant to be purely a commercial one, it is also about delivering a public good for the region – creating a knowledge capacity, to enable future economic growth that would otherwise be unlikely to occur.

Due to the problems summarised, my proposed institution therefore needs to be independently funded, probably through ODA from multilateral sources in a similar way as the multilateral banks are. I am also opposed to this organisation being located within an existing institution either: as such, a function is different to the current multilateral functions of a development bank. Just as a CRA operates independently from the other investment industry functions, so would this institution need to do. I do not want this institution's functions, to be captured by any kind of bank or existing organisation.

- **Expand the availability of political risk transfer and credit enhancement tools:**

Expand or replicate the capacity of MIGA (risk-management method four). Currently private investors have two ways of managing political risk, and both utilise the existing DFIs (development finance institutions), and their inferred political influence.

**Firstly**, they can use the MIGA (Multilateral Investment Guarantee Agency) facility of the World Bank: which is in effect an insurance scheme offering political risk insurance and credit enhancement guarantees. It currently offers five classes of insurance product: Currency Inconvertibility and Transfer Restriction coverage; Expropriation coverage; War, Terrorism, and Civil Disturbance coverage; Breach of Contract coverage; Non-

Honouring of Financial Obligations coverage [miga.org]. This scheme appears to be working well, but it is a global scheme that is limited in its capacity to cover SSA. Therefore, it needs a replication of similar insurance capacity either by other well-resourced institutions or by expansion of its current capacity.

Even though these tools are useful, and in keeping with some of my findings, they are not yet comprehensive and have a (potentially prohibitive) cost in what is a normal margin business (chapter 2, sec.4.2) and so cannot be described as a silver bullet. According to the MIGA annual report, SSA only received US$18.4 billion of guarantees [Ibid], this is nowhere the financial capacity required (US$2 trillion) to nullify electricity poverty in the region described at the beginning of this chapter.

**The second** method that DFIs offer to help control political risk and enhance credit is by *crowding-in* [ICA, 2017; IEA, 2019]. In my research context, this involves the following: one or more DFIs will become early 'cornerstone' investors in a project and because of their expertise and implied power as a representative of the DAC community, act as protectors of all the corresponding investors. They are in effect sharing their position and knowledge as a DFI as an externality benefit of protection, which is used by the remaining investors in the project. This is a cheaper form of cover, as there is no direct cost. As a form of protection, for some it will be too weak as it is implied and less comprehensive as a risk mitigation tool. It is also limited to the projects that the DFIs choose or can support. That said, it is helpful and useful and needs its expanding as a tool.

- **Improve the level of capabilities for infrastructure project delivery** (risk management method three).

There is a limitation in the level of skills and capabilities available for delivering infrastructure projects efficiently in the sub-Saharan region. These skill shortages affect all stages of projects: from initiation; through design, construction, and commissioning; to operation and maintenance. They are responsible for the region's relatively high project development costs, low project quality and weak operating performance. These are particularly associated with my **key finding V, market-breakdown four**.

Such project skills and capabilities are usually developed in two broad ways. They are either created as individuals undertake education and training in universities, technical colleges, and similar organisations (codified knowledge); or they are enhanced by *learning by doing*. This involves programmes of training, apprenticeship, and mentoring:

usually within firms. This second part of the skill transfer process involves the acquisition of tacit knowledge and is an essential element of innovation [Bell & Pavitt, 1993]. The usefulness of codified knowledge is dramatically improved when it is enhanced by *learning by doing* [Scott-Kemmis & Bell, 2010].

As I mentioned in my **key finding V, market-breakdown four**, firms within SSA are not currently developing these skills, and it should be a policy priority to discover how to remedy this.

## *4.4 Prioritise the improvement of the functionality of utilities*

As emphasised in my conclusion of my second co-authored paper: if a centralised electricity, delivery system is to be persevered with for delivering electricity services within SSA – experienced, knowledgeable, and skilled managers must manage it. Without the improvement of the efficiency of utilities and the surrounding government-controlled structures, electricity poverty within SSA will remain a stubborn policy problem. This is essentially an issue of capabilities, the resolution of which I have already covered.

Recognising that this may be difficult to achieve, because of factors of domestic politics in the countries concerned (**key finding VI**), it may be necessary for policy makers to consider alternative choices. Options that can succeed, despite the failings of a centralised electricity delivery system (if that is possible); or explore possible ways to replace the existing system, with a decentralised one. This represents a motivation behind my new perspective for policy that I will feature in section five.

## *4.5 Internalising externality spillover benefits*

As I explained in my **key finding VIII** and in in chapter 2 (sec.4.8), the value of the externality spillover benefits that would be created by delivering universal, reliable, and affordable electricity access to SSA, are substantial. However, this value is very difficult for the private sector to monetise through internalisation, permitting their legitimate appropriation. It is this policy truth, which is probably the most compelling reason for promoting a public sector narrative over a private sector one, when seeking a solution to African electricity poverty: as the state does have the ability to appropriate such value through its ability to raise taxes. Conversely, the creation of this externality value, also represents a compelling reason for promoting the policy of private sector sourced

financing – as through that policy's success, there will be a substantial value transferred to a recipient economy, with no recompense to those who have created the value and transferred it: the 'private' actor.

This is definitely a policy conundrum: and reminds me of the philosophical debate between the *consequentialists* (Jeremy Bentham & John Stuart Mill) and the admirers of the *categorical imperative* (Immanuel Kant). As the positive externalities of electricity access are substantial and diffused, I would argue from a development policy perspective: the achievement of universal electrification in SSA is more important than how it is attained.

As discussed specifically in Chapter 2 sec.4, and throughout this thesis, a traditional private investor is seeking a minimal level of return to justify their engagement as an investor – but this is difficult to attain in SSA. This is partly due to the inability to appropriate the spillover benefits associated with the delivering a general-purpose technology (Introduction, sec.1.2) to an economy that doesn't have affordable and reliable access to it – but it is also because so much economic value is lost through the risks described in Chapter 4 of this thesis. If the loss of value through risk can be minimised, it may be realistic to believe the value that cannot be appropriated from the spillover, may actually not be required to make such investment attractive enough to private actors.

If externality spillover value is still required to make the investment maths attractive, the only spillover value that I have been able to identify through my research, that has the potential to be internalised, is the strategic value to the international community that a functioning state using climate friendly technologies represents. This type of value could also bypass my **key finding VII** concerning the exchange of currency.

The obvious way to internalise this, is through a form of subsidy. However, with the current frictions surrounding ODA from the electorates of many OECD countries – such subsidies are probably too politically awkward to administer to a private entity in my research context. It would therefore be necessary to be more creative in designing such solutions. I note that this has been tried with failure in the past, when the Clean Development Mechanism had promised such value through the creation of Carbon-Credits, but then had a minimal impact on SSA (causing substantial angst within African Policy circles). There is currently such potential through article 2.1c of the Paris Agreement, which could be a subject for further research. There may also be the potential

to overcome this, through a radical new approach to repositioning how households are defined within the electricity delivery regime – which I discuss in section 5.2.

## *4.6 Areas for future research that arise out of this thesis*

### 4.6.1 Marginalised rural stakeholders of electricity services

I have identified a research need to explore whether it is possible to redefine how poor African rural households function as a stakeholder group, within their country's electricity delivery systems. Currently, such electricity delivery systems, have a disposition towards the urban populations of the country, in their organisation, governance and their electricity value propositions. Consequentially, rural households find themselves excluded as stakeholders from the electricity delivery system, as they are not sufficiently wealthy for the system to desire them as customers. Inevitably, if their electricity system ignores such households as stakeholders, then they in return will not see any arrangements surrounding that system as legitimate and will consequentially not support the integrity of the system in return. Such an actuality encourages both the theft of electricity, and theft/vandalism of the physical infrastructure; and leaves the entire network vulnerable to political opportunism.

I am advocating that there should be research to see if the current energy technology transition, from fossil fuels to renewables, can also be used to redefine what the rural poor of Africa can represent as stakeholders within their country's electricity delivery systems. It appears possible to use the distributive and modular traits of how renewable technologies function, to possibly transform poor rural households from being stakeholders that cannot afford to consume electricity (and are marginalised), to becoming stakeholders at the heart of their electricity system.

It should be possible to reorganise rural communities to become effective electricity generators, where they can consume and generate an electricity surplus simultaneously, just as fishermen and farmers can feed their families whilst simultaneously securing a living to support their families. This would transform them from signifying stakeholders who currently see no value in supporting the current electricity service system, as it marginalises them and represents zero value to them and their community – to stakeholders who can rely on the electricity system to supply their livelihoods: meriting support and improved legitimacy, compared to the current status-quo.

### 4.6.2 Classifying the risks surrounding the development of nuclear power for electricity generation, in sub-Saharan Africa?

One gap in my research, concerns the development of nuclear power technology, for electricity generation. As I touch on in my concluding remarks in the next section, my topography of study for this thesis has been pan-African, to which I have taken a top down approach – looking at both the governance and the financing of electricity systems for the region of SSA. This has then particularly examined the problematic nature of large scale and novel technology projects. It seems a natural fit therefore, for my technology evaluation to be extended to include nuclear fission technologies.

During my numerous visits to South Africa, carrying out research for my thesis (which included attending pan-African conferences), I have been able to identify both an interest from governments in the region to develop nuclear power generation capacity, and vendors of such technology (particularly Russian) to concentrate their promotional efforts, on this region too. Whilst I do not anticipate that such technology development would be privately financed, I do anticipate an increased likelihood that state actors will increase their pressure for such development in the region, which will include its financing. Following my Section 1.2 in this Chapter, I believe the most realistic actor to be China. With this focus in mind, I think it is necessary for thorough and authoritative research to be conducted, that appreciates the difficulties and legacy issues that could arise out of such a technology development. I also think my research on Medupi and Kusile would lead into such research, quite nicely.

# 5. Concluding remarks

Back in 2015, when I decided that I wanted to author a PhD but was not yet familiar with what it would entail – I was very solutions focused and approached my subject as if the region was a single entity. This approach was very quickly amended, as I started to engage with the various academic institutions that I had identified, when all counselled me that that the scope of my research was unrealistic in its scale of investigation that a pan African approach would entail. I was also anticipating that much of my research, would require interviewing investors about what aspects discouraged their investment appetite in SSA. I am therefore aware of two potential criticisms of this thesis, that I wish to close down before concluding it:

- Why I am treating SSA in my thesis as a single entity, as each country is unique and have their own problems and needs: which I completely recognise and concur with incidentally.
- Why I have not sought investor's opinions directly, for why they are not investing in SSA?

I recognise that these both appear to be legitimate and important observational questions – hence my desire to explain why I have not applied either of them in my analytical approach and data collection, for my research subject.

## Investment decisions to proceed are homogenous

One of the early lessons I learnt once I proceeded with my research, was the importance of perspectives: how I chose to analyse my research problem. Initially I acted on the advice I had received about cutting back my area of scrutiny and chose a manageable sample of three countries: Kenya, Tanzania, and Mozambique, for my first published paper. As my research expanded and I started to unpack my research problem however, it soon became apparent that I needed to re-appraise my perspective. My research problem was one for investors, not the recipients of their funding – and investors have uniformity in how they approach investment: as I explained in my conceptual approach in chapter 2, section 4.

Investors all have three questions when they decide where and how to invest, which as I said in section 4.5, acts as my risk filter:

(i) Is it realistic to expect a reimbursement of the value of the investment (the initial cost) in the future?
(ii) Is it realistic to expect to receive the anticipated returns (the rewards) when they are expected?
(iii) How does this investment opportunity, compare with every other investment opportunity that is available?

Due to this reappraisal of perspective, I therefore argue that it is reasonable for me to take a pan sub-Saharan approach, rather than just focus on a small sample of countries.

These same three questions are also the reason that I never relied on investor sourced data for this thesis. After commencing with my research, I did interview some investors. Some of the South African investment banks and Aldwych International (who were the

developer of the Lake Turkana wind farm, in Kenya) were the most significant, but I soon realised that this had predominantly been the approach of others past research: particular *grey* or practitioner research. I also conjectured that this had not delivered a workable understanding of my research problem, as if it had the policy failure of private financing, would probably not be an ongoing policy failure. Within my first year of analysis, I therefore decided to just focus on approaching my problem from a theoretical approach, utilising finance academic theory.

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