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The Potential Role of CSP in South Africa

Case Study: The Bokpoort CSP Project, South
Africa

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Abstract

South Africa (SA) has an energy intensive economy that is historically dependent on cheap coal for generating electricity. Yet, over the past few years the country has been plagued by critical energy supply constraints. In light of this, Concentrated Solar Power (CSP) with thermal storage has created interest as a possible power provider given SA's abundant solar resources and the technology's ability to store power and to dispatch it during periods of high demand.

This study investigated the potential role of CSP in SA, utilizing the Bokpoort 50 MW CSP plant as a case study. This case study was used to explore the financial viability of CSP in the country, as well as to assess the risks and challenges experienced by the Bokpoort plant, and CSP in SA. It also aimed to identify alternative debt financing mechanisms while providing recommendations for the improvement of REIPPPP and the future deployment of CSP in SA. To achieve this, the research paper made use of interviews and industry research. The study also included a discounted cash flow model to estimate the NPV, IRR and LCOE of the Bokpoort project.

Through interviews and literature research, the study highlighted the potential environmental and socio-economic of CSP for SA. Through the analysis of the Bokpoort plant, it identified a number of risks and challenges facing CSP in SA. These included regulatory and licensing challenges, financial challenges and construction challenges.

The financial analysis undertaken calculated a Net Present Value (NPV) for the project at US\$ 165.82 million. An Internal Rate of Return (IRR) stood at a reasonable at 5.48% and the levelized cost of electricity (LCOE) was a low US\$ 0.20/kWh. The impact of different discount rates and capital cost reductions on these economic indicators were also taken into account.

In light of the limited availability of debt finance for renewable energy projects in SA, this research paper found the following mechanisms to widen the debt base in SA: Debt refinancing, securitization, Yieldco, climate financing, retirement funds and DFIs. This study also recommends that REIPPPP simplify its bid requirements, which will reduce transaction costs and time delays. Lastly, this study recommends that government pursues a CSP fleet procurement programme. This will provide manufactures with a pipeline and will ensure that CSP is deployed at scale that is necessary to reduce costs and to provide energy security.

In the end, this paper argues that CSP holds numerous benefits for the country. However, current risks and challenges need to be addressed in order to ensure that it impacts strongly and positively on SA.

Key Words: CSP, South Africa, Bokpoort, REIPPPP

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List of Acronyms

AMCU	Association of Mineworkers and Construction Union
BBBEE	Broad-Based Black Economic Empowerment
BEE	Black Economic Empowerment
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
COP	Conference of Parties
CSP	Concentrated Solar Power
DBSA	Development Bank of Southern Africa
DCF	Discounted Cash Flow
DEA	Department of Environmental Affairs and Tourism
DFIs	Development Financial Institutions
DNI	Direct Normal Irradiance
DoE	Department of Energy
ED	Economic Development
EPC	Engineering Procurement and Construction
GHG	Greenhouse Gas
IDC	Industrial Development Corporation
IRP	Integrated Resource Plan
IRR	Internal Rate of Return
kWh	kilowatt-hour
LCOE	Levelized Cost of Electricity
LMSCF	Lereko Metier Sustainability Capital Fund
LMSF1	Lereko Metier SolAfrica Fund
LTMS	Long-Term Mitigations Strategies
MEC	Minerals- Energy Complex
NERSA	National Energy Regulator of South Africa
NGO	Non-governmental Organisation
NPV	Net Present Value
NUMSA	National Union of Metalworkers of South Africa
O&M	Operation and Maintenance
OCGT	Open Cycle Gas Turbines
PV	Solar Photovoltaic

RE	Renewable Energy
REFITs	Renewable Energy Feed-in Tariffs
REIPPPP	Renewable Energy Independent Power Procurement Programme
RfP	Request for Proposal
SA	South Africa

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1. Introduction

South Africa (SA) has an energy intensive economy and one that has been historically dependent on cheap coal for generating power. At present, this form of power accounts for approximately 70% of the country's power and 90% of its electricity (Eberhard *et al.*, 2014; Baker, 2011).

Prior to 2011, SA had one of the world's lowest renewable energy (RE) penetration levels - at just 1% - compared with other major developed or emerging economies (Boyd *et al.*, 2014). In response to the country's urgent need to address critical energy supply constraints, increasing international pressure placed on it to decarbonise its energy supply, as well as having the political will to create a sustainable renewable energy industry that would address environmental and socio-economic challenges, SA's Department of Energy (DoE) introduced the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in 2011 (Papapetrou, 2014).

REIPPPP was established in line with national development goals whereby it has a number of environmental, economic development and financial criteria which all participants need to adhere to. The programme's aim is to mobilise renewable energy investment (mostly from the private sector) and to achieve the country's emission reduction goals. These goals include the commitment made by SA at the Copenhagen Conference of Parties (COP) in 2009 to reduce its CO₂ emissions by 34% below the business-as-usual scenario by 2020, and below 42% by 2025 (Papapetrou, 2014; Baker and Wlokas, 2014).

Despite SA being critiqued in the past for its heavy dependence on fossil fuels for power generation, its REIPPPP Programme has been praised by the international community as arguably one of the world's most successful IPP programmes. This is because it has created a platform for the extensive roll-out of RE in SA, thereby jump-starting the industry (Papapetrou, 2014). Moreover, it has channelled substantial private expertise and investment into RE projects at competitive prices. Following 4 competitive tender bidding rounds, 79 preferred bidders have been selected (DoE, 2015; Eberhard *et al.*, 2014). As a consequence, the programme has been ranked in the top 10 globally for renewable energy IPP investments since 2012. It has hosted the fastest growing clean energy market over the past 3 years and has secured more IPP investments than any others across the African continent over the past two decades (Eberhard *et al.*, 2014; Sager, 2014).

To date, onshore wind and solar projects have dominated the 4 bidding rounds. Solar photovoltaic (PV) energy is the most popular solar technology, whereby a large portion of resources have been allocated to solar PV in contrast to concentrated solar power (CSP) (CSIR, 2015; PV Insider, 2014).

Nevertheless, CSP is still seen as important. It remains of particular interest given the country's abundant solar resources, since it may help it overcome gaps between demand and supply - SA currently needs a mechanism to provide reliable low-emissions baseload energy and to assist in growing demand for peak load provision (Papapetrou, 2014; Eberhard *et al.*, 2014). CSP with thermal storage would do this through its ability to store solar energy, and feed this energy into the grid after sunset and during peak hours (Boyd *et al.*, 2014).

As of today however, the two low-emissions baseload options that have been considered by the SA Government are Carbon Capture and Storage (CCS) facilities on coal-fired power plants, and nuclear power (Pfenninger and Kierstead, 2015). Despite this, CCS is still an unproven technology on a commercial scale, and therefore there remains a lot of uncertainty surrounding the technology, its future availability and the costs of such CCS power plants (Pfenninger and Kierstead, 2015). Furthermore, nuclear has been favoured by many countries as a low-emissions baseload power generator, including the SA government. This is because it is a mature technology with sufficient fuel for large-scale deployment. However, in the wake of the 2011 Fukushima nuclear disaster, nuclear power has received low public acceptance due to its high risks (Hayashi and Hughes, 2013).

That said, CSP (with thermal storage) investments and production costs remain high compared to PV energy and more established alternative conventional options, such as fossil fuel generation and hydro-power energy (Boyd *et al.*, 2014; PV-Insider, 2014; Smith, 2015). Still, there remains growing international demand for both renewable energy and energy storage, and given CSP's thermal storage capability, this technology will be able to provide energy security and grid stability in a new energy system characterised by high penetration of fluctuating power from PV and onshore wind (Hayashi and Hughes, 2013).

The Bokpoort CSP plant in SA will be used as a case study to analyse the potential role of CSP in SA. The project is located at Bokpoort farm in the Northern Cape Province of SA. The plant was awarded in the second round of REIPPPP in 2012. It is a 50 MW net parabolic trough plant that, to date, has the largest thermal storage ever adopted for a CSP plant of this size and this specific technology. Its storage capacity will be 9.3 hours (1300 MWh) enabling it to yield a generation in excess of 200 GWh/year (ACWA Power, 2015; Thomson Reuters, 2013). This project is estimated to cost US\$ 565 million. Project finance has been its primary funding method, where its financing structure is made up of a debt-to-equity ratio of 71% and 29% respectively (ACWA Power, 2015; Boyd *et al.*, 2014). This CSP plant will be used to analyse the financial viability of CSP, to identify risks and financial barriers, and to provide recommendations for future projects.

1.1. Case Study Motivation

Wind and PV dominate the renewable energy landscape in SA due to an abundant supply of both resources. However, SA needs a renewable energy technology that has the capacity and capability to store energy to address peak demands as well as to provide baseload power. Given the dispatchable power nature of CSP and baseload potential, compared to alternative RE options, it could prove to be an important mechanism to both SA and Africa in the future. However, thus far its high financial costs and risks (section 4.7.) have been the main barriers to its implementation in SA and other countries (Stadelmann *et al.*, 2014). Despite this, the Bokpoort CSP plant's 9.3 hour (1300 MWh) storage capacity makes it the most suitable technology to be deployed in SA since it will be able to address peak demand, reduce CO₂ emissions, as well as provide employment and socio-economic benefits to local communities.

This plant is an ideal case study since it is a landmark in REIPPPP with its first-of-its-kind parabolic trough technology, while also having a unique economic empowerment funding structure (this will be explored further in section 2.5 and section 4.2) (Thomson Reuters, 2013). Moreover, given the importance of this technology, it makes it a suitable case study to explore the potential role of CSP in SA by determining the financial viability, risks and challenges experienced by this project. Also, since this technology is largely financed through debt provided by domestic financial institutions, it is important to investigate potential options to broaden the debt financing base, which could result in a reduction in costs. This is mostly because the liquidity of SA's debt market is limited (Papapetrou, 2014).

1.2. Research Question

- What is the potential role of CSP in SA's renewable energy market?

1.3. Aims & Objectives

- To demonstrate the market potential of CSP in SA.
- To assess the financial viability and the risks/challenges associated with the Bokpoort plant (as well as those risks facing CSP generally in SA) by assessing 3 dimensions:
 - Institutional relationships and the project's financial structure.
 - Financial feasibility (discounted cash flow model estimates).
 - Risk assessment and mitigation measures

- To identify alternative debt financing mechanisms
- To provide recommendations for the improvement of REIPPPP and for the future deployment of CSP plant in SA.

1.4. Structure of Study

Section 1 'Introduction' - This section will provide a brief background on SA's electricity sector, REIPPPP and CSP. It will also provide a brief motivation for the use of the Bokpoort 50MW CSP plant in SA as a case study. Moreover it will also outline this paper's research question, aims and objectives.

Section 2 'Literature Review' - This section will evaluate existing literature on SA's electricity sector, CSP globally and in SA, as well as that on the Bokpoort CSP Plant.

Section 3 'Methodology' - This section will explain its mixed research methods approach (qualitative and quantitative), where it will briefly describe the interviews and discounted cash flow model.

Section 4 'Findings and Discussion' - This section will identify the key findings and benefits prevalent in the research conducted, namely: SA's solar resource, dispatchability and grid stability, as well as socio-economic benefits and low environmental impacts.

Section 5 'Recommendations'- This section will provide recommendation for the improvement of REIPPPP and the future deployment of CSP in SA.

Section 6 'Conclusion' - This section will finalise the key points echoed throughout the document.

2. Literature Review

2.1. South Africa's Electricity Industry

Accessible, cheap and reliable electricity has been essential to SA's development over the past century (McDonald, 2009). SA's low-cost electricity and abundant natural resources led to an advancement that was based on heavy industry and mining during the 1900's - this developmental path is referred to as the Minerals-Energy Complex (MEC) (Fine and Rustomjee, 1996). However, a consequence of the MEC was that SA's economy was distinctively dependent on cheap electricity since mining and its related activities depend on large quantities of electricity. This made SA's economy "uniquely energy-intensive" (Fine and Rustomjee, 1996:8).

Central to the MEC was SA's state-owned power utility, Eskom Holdings Limited (Eskom). Eskom was responsible for the generation, transmission and distribution of electricity throughout the country. It is also in charge of purchasing and selling electricity to and from neighbouring African countries (Baker, 2011). It is responsible for producing 96% of SA's electricity and 45% of Africa's with its coal-fired power plants generating more than 90% of this electricity (Figure 1) (Eberhard *et al.*, 2014; Eberhard, 2011; Eskom, 2015). Due to SA's large coal reserves, this resource has been favoured as the main source of fuel and has been pivotal in the country's historically low electricity prices. By the end of the 1990's, the country's electricity prices ranked amongst some of the cheapest in the world (Eberhard, 2011).

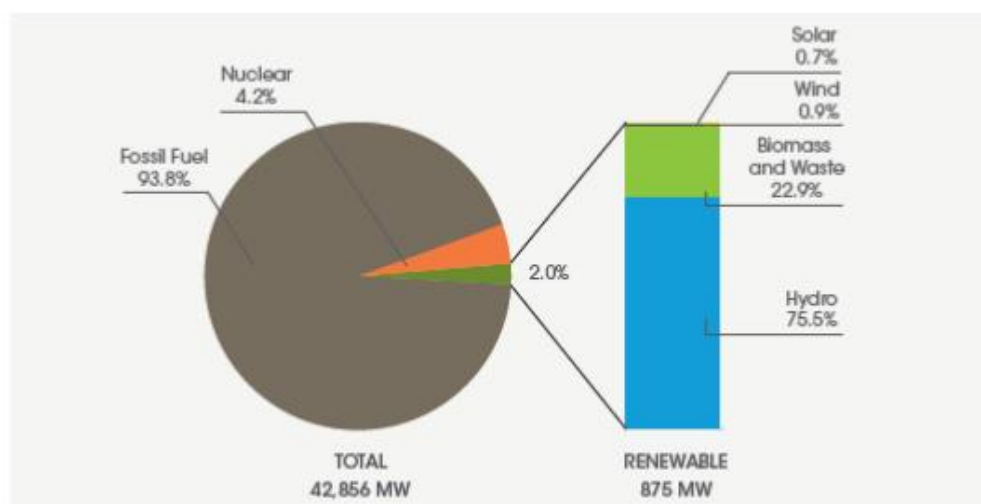


Figure 1: South Africa's Electricity Generation Prior 2011

Source: IRENA (2012)

Yet by the early 2000's, SA electricity sector experienced a significant shortfall in its generation capacity that saw a drop in its reserve margins (Trollip *et al.*, 2014). Consequently, the country experienced an energy crisis in 2008 which, in addition to a decline in reserve margins, was attributed to an inadequate and unreliable supply of coal, poor maintenance of infrastructure, and crucially, a failure to create the conditions necessary for adequate investments in infrastructure over the previous two decades. According to South Africa's DoE, "over the past 20 years South Africa has not made significant investments in the energy sector" (DoE, 2012: 35).

In response to this, Eskom initiated both demand and supply side interventions that included a power plant expansion programme in 2005, which involved the construction of two new coal-fired power plants, Medupi and Kusile (Eberhard *et al.*, 2014; Sager, 2014). It also involved a sign off by the National Energy Regulator of South Africa (NERSA) for upward adjustments of energy tariffs as means for demand-side management as well as to sustain the financial viability of Eskom (figure 2) (Trollip *et al.*, 2014; Baker, 2011; Eberhard *et al.*, 2014). Despite these efforts there continue to be rolling black-outs as energy demand exceeds supply. These are largely attributed to cost overruns and time delays of the aforementioned new baseload coal power plants. Figure 2 highlights the decline in energy production over the past four years. Consequently, the cost of this unserved energy to the country's economy has been significant while simultaneously exacerbating poverty and inequality.

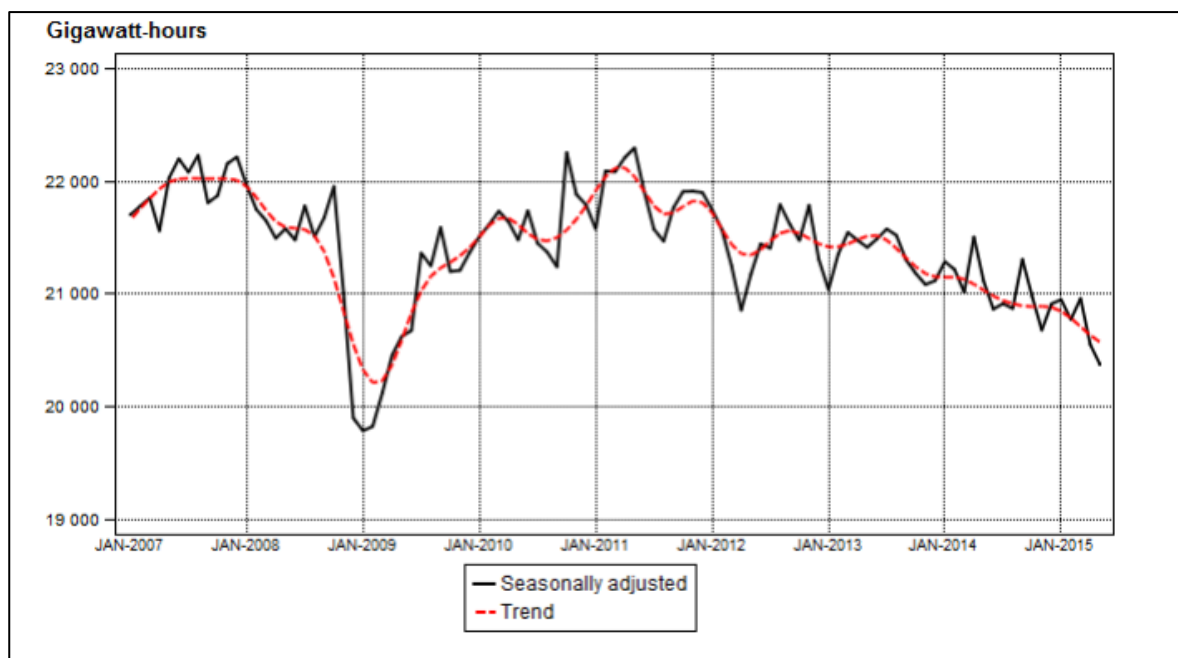


Figure 2: Electricity Generated in South Africa from 2007-2015

Source: Stats SA (2015)

There has also been significant public concern surrounding the environmental and social risks of these coal-fired plants, as well as the latter's entrenchment of SA's fossil fuel growth path with their 50 year lifespans (Eskom, 2013). As a result, this is making SA's electricity industry and economy susceptible to future carbon taxes and regulations (Sager, 2014).

2.2. South Africa's Renewable Energy Policy Landscape

The Post-Apartheid South African Government has implemented a number of energy related policies over the past 2 decades. A specific feature of this Post-Apartheid regime is that it no longer leaves the power planning exclusively to Eskom, and it requires RE to play an important role in SA's future energy mix (Eberhard *et al.*, 2014).

In 1998, SA released its publication of the Energy White Paper Policy (DME, 1998). This publication disclosed its objectives to reform the energy sector that included both environmental and socio-economic objectives (DME, 1998). Moreover, it also discussed the restructuring and unbundling of Eskom (DoE, 1998). Following that publication, government decided that IPPs should be allowed to enter the SA market and contribute towards new generation capacity. Thus in 2001, Cabinet agreed to split new power generation investment between Eskom (70%) and IPPs (30%) (Boyd *et al.*, 2014; Eberhard *et al.*, 2014).

In 2003, the SA government showed its commitment to RE by setting targets in its 2003 publication of a Renewable Energy White Paper Policy (DME, 2003). This publication discussed the role of RE in the future energy mix and identified measures to bring RE into the mainstream energy economy. In this document the government set out targets which included the generation 10 000 GWh of RE by 2013 (DME, 2003). By that time, this target had not been achieved.

Although national RE policy has so far been unsuccessful in achieving its objectives, policies to mitigate climate change have been more successful. In 2007, the SA Department of Environmental Affairs and Tourism (DEA) commissioned work on Long-Term Mitigations Strategies (LMTS), which formed the basis for president Jacob Zuma's pledge at the Copenhagen COP in 2009 to reduce CO₂ emissions by 34% below the BAU scenario by 2020 (DEA, 2007; Eberhard *et al.*, 2014). The LMTS also outlined 'Peak, Plateau and Decline' (PPD) GHG emissions mitigation trajectories (DEA, 2007). These trajectories were used to inform the development of the Integrated Resource Plan (IRP) 2010-2030, which was published in 2009 (DoE, 2013). This document stipulates how much new generation is needed and allowed during the 2010–2030 period, and from what sources. The IRP will be regularly updated. It was last updated in 2013.

Furthermore, in order to achieve its emissions pledge made in Copenhagen, SA explored measures to expand its RE supply. One of these options included the introduction of RE feed-in tariffs (REFITs) (Eberhard *et al.*, 2014; Papapetrou, 2014). In 2009, the REFIT policy was approved by NERSA. Tariffs were designed to cover a number of costs and tax returns; however, there was uncertainty surrounding the nature of RE procurement, the licensing process as well as Eskom's support for the REFIT programme since Eskom did not commit to providing power purchasing agreements (PPAs) (Eberhard *et al.*, 2014; Papapetrou, 2014). As a consequence, in 2011 NERSA abandoned REFIT and introduced the competitive tender bidding process REIPPPP (this will be discussed in section 2.3).

2.3. Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)

As previously highlighted, REIPPPP was introduced in 2011 by the DoE thanks to a host of institutional shortcomings in the SA's energy sector. By some measures, the programme has so far been extremely successful. It has created a platform for the private sector to develop projects and enter into PPAs with Eskom (single off-taker), thereby creating the necessary groundwork for SA to become a leader in RE (Papapetrou, 2014).

Through the use of a competitive tender bidding process, the programme aimed to stimulate investments in SA's renewable energy industry as means to assist the country in achieving the IRP 2010-2030 RE targets (Sager, 2014). Initially, the programme aimed to procure 3,725 MW over 5 bidding rounds, where caps would be set on the total capacity to procure for each round and on each technology within that round (Eberhard *et al.*, 2014). These caps were put in place to limit supply in each bidding round, thereby increasing the competition among the different RE technologies and bidders, driving down bid tariffs (Eberhard *et al.*, 2014; Papapetrou, 2014; Sager, 2014). Furthermore, price caps were imposed in rounds 1 and 2 to serve as reference points in procuring RE. However, these were removed for PV and onshore wind in round 3 due to increased competition which resulted in the fall of prices. Yet, after 3 bidding rounds, 916 MW was allocated. Then, at the beginning of 2014 the DoE opened a CSP-only bidding round (3.5 round) (Sager, 2014). To date, 4 bidding rounds have been completed and 79 'preferred bids' (projects) have been selected (Table 1 and Figure 3)

Table 1: Review of REIPPPP Rounds 1, 2, 3, 3.5 and 4

Source: Roberts (2015)

Technology & province	Number of projects approved						Capacity of projects approved (MW)					
	Bidding Window						Bidding Window					
	1	2	3	3.5	4	Total	1	2	3	3.5	4	Total
Biomass	-	-	1	-	1	2	-	-	16	-	25	41
KwaZulu-Natal			1			1			16			16
Mpumalanga					1	1					25	25
Landfill Gas	-	-	1	-	-	1	-	-	18	-	-	18
Gauteng			1			1			18			18
Onshore Wind	8	7	7	-	5	27	634	559	787	-	676	2 656
Eastern Cape	5	5	2		3	15	470	333	197		396	1 395
Northern Cape	1		5		2	8	73		590		280	943
Western Cape	2	2				4	92	226				318
Small Hydro	-	2	-	-	1	3	-	14	-	-	5	19
Free State		1			1	2		4			5	9
Northern Cape		1				1		10				10
Solar CSP	2	1	2	2	-	7	150	50	200	200	-	600
Northern Cape	2	1	2	2		7	150	50	200	200		600
Solar Photovoltaic	18	9	6	-	6	39	632	417	435	-	415	1 899
Eastern Cape		1				1		70				70
Free State	1	1	1			3	64	60	75			199
Limpopo	2		1			3	58		60			118
Northern Cape	11	5	3		6	25	389	270	225		415	1 299
North-West Province	2					2	79					79
Western Cape	2	2	1			5	41	18	75			134
Grand Total	28	19	17	2	13	79	1 416	1 040	1 456	200	1 121	5 233

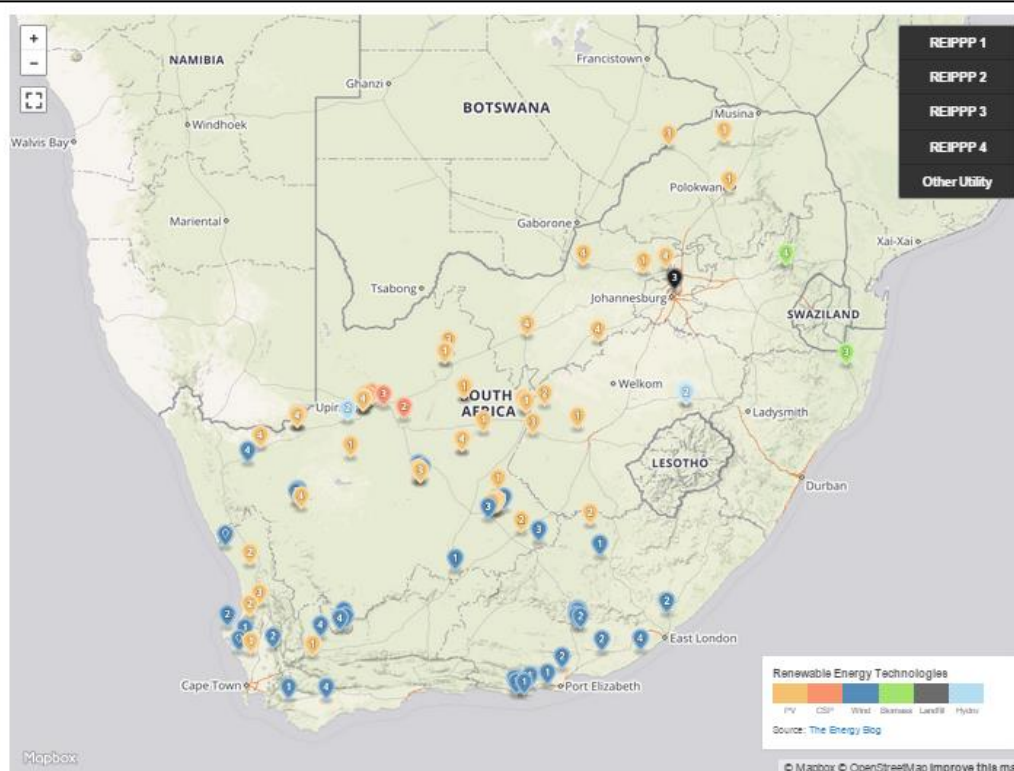


Figure 3: South Africa's Renewable Energy Project Sites

Source: Energy Blog (2015)

REIPPPP's bidding process follows a two-stage approach in evaluating projects (Sager, 2014; Papapetrou, 2014; Eberhard *et al.*, 2014). Firstly, projects need to adhere to a minimum criteria

which includes both financial and non-financial aspects (Table 2). This ensures that chosen projects will be ‘shovel-ready’, thereby ensuring the efficient and fast deployment of projects.

Table 2: Qualification Criteria

Source: Papapetrou (2014)

CRITERIA	NECESSARY INCLUSIONS
Project Structure	Project participants: equity participants, lenders, contractors, equipment suppliers, black enterprises and local community members
Financial	Price (full indexation and partial indexation), financial standing of project sponsors, robustness and deliverability of funding proposal, robustness of financial models
Legal	Legal status of the project company, acceptance of project agreements (i.e. PPA, Implementation Agreement, Direct Agreement), Statements by Members
Technical	Proven technology, energy resource availability, generation forecast, project schedule, cost and timing of grid connection, deliverability of project, water consumption
Land / Environmental	Title deeds, notarial leases, land options, Environmental Impact Assessments or Basic Assessment Reports, water and waste management license prerequisites vary by technology
Economic Development	Various minimum thresholds for SA ownership, job creation, manufacturing, local content, black ownership including local communities, preferential procurement, enterprise development, socio-economic development
Fees and Bid Guarantee	Bid submission: R100,000 per MW; Preferred Bidder: R200,000 per MW; Development Fee: 1% of total project cost

Secondly, once the projects have met the above mentioned criteria (Table 2), they are evaluated on a weighting system, with the price per kilowatt-hour (kWh) weighted at 70% and socio-economic development weighted at 30% (DoE, 2015; Sager, 2014). Successful projects are awarded ‘Preferred Bidder’ status and are granted a fixed amount of time to reach financial close (Sager, 2014). Following this, NERSA approves the final PPA between the project developer and Eskom. Figure 3 provides a simple illustration of REIPPPP’s structure.

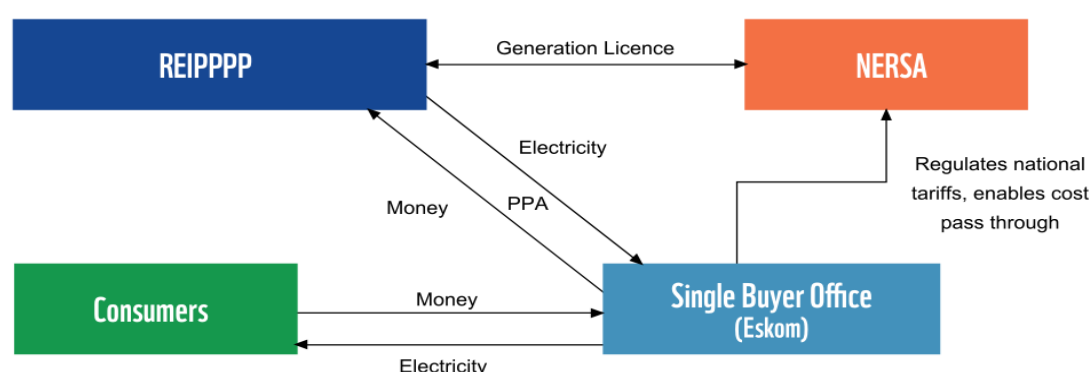


Figure 4: REIPPPP Structure

Source: Papapetrou (2014)

Significant results have been achieved thus far, especially in reducing the cost of electricity procurement from the different RE technologies, as well as introducing and scaling-up of the local content of procuring electricity (Table 3). Over the past 4 years, bid tariffs (from an LCOE perspective) have fallen significantly, with solar PV and wind having reached pricing parity with supply from new coal fired power plants (Sager,2014). Although CSP remains more expensive than other RE technologies, costs have decreased over the bidding rounds with it now costing less than the alternative peaking supply option, namely diesel-powered open cycle gas turbines (OCGT)(Sager,2014).

Table 3: REIPPPP Average Bid Prices, (Rand cents/kWh)

Source: Eberhard et al.,(2014)

	Round 1	Round 2	Round 3
Wind	114.3	89.7	65.6
Reduction from previous round		-21.5%	-26.9%
Total reduction from round 1			-42.6%
Solar PV	275.8	164.5	88.1
Reduction from previous round		-40.4%	-46.4%
Total reduction from round 1			-68.1%
Concentrated solar power	268.6	251.2	146.0*
Reduction from previous round		-6.5%	-41.9%
Reduction from previous round			-45.6%

This reduction in bid tariffs is attributed to a number of factors. These include, firstly the introduction of a competitive bidding process as well as the introduction of price caps in the first two bidding rounds. The fierce competition in the bidding rounds drove down the bid prices, where the competition was partly due to a weak global economy and fewer RE investment opportunities elsewhere, as well as REIPPPP providing the private sector the opportunities to exploit inefficiencies in the electricity sector (Papapetrou, 2014; Sager, 2014). Secondly, the acceptance of reduced equity returns from equity investors, whereas the risk of RE technologies and projects decline with time and experience, so does the programmes risk premium (Sager,2014; Eberhard *et al.*, 2014; Papapetrou, 2014). Fortunately, under such circumstances REIPPPP has been able to attract foreign investors who are willing to accept lower returns than domestic investors (Sager, 2014). Thirdly, SA's commercial banks have been pivotal in providing debt financing to projects. A study conducted by Eberhard *et al.*,(2014) calculated that 86% of overall debt financing in rounds 1-3 was provided by domestic financial institutions. International institutions have been slow to participate due to a

number of risks that include regulatory, market and foreign exchange risks (Sager, 2014). Lastly, PV has experienced a market shake-out over the past 5 years which has led to significant price reductions (70%) across the bidding rounds as supply has expanded faster than demand (Sager, 2014).

Still, there is concern that potentially escalating local content or economic development (ED) requirements in REIPPPP may result in investors and developers exploring other options and markets such as embedded generation, off-grid generation and utility-scale generation in other emerging countries on the continent and elsewhere (Sager, 2014). Moreover, policy uncertainty, especially surrounding the future of REIPPPP, has hindered further investments in local production of these technologies. This is of most concern for the CSP industry since production globally is relatively small and the industry is constrained due to the variety of CSP technology designs (Sager, 2014). This creates further worry, because in order for REIPPPP to be a major threat to Eskom's monopoly it needs to procure baseload power (Trollip *et al.*, 2014).

To date, domestic commercial banks have played an important role in providing debt financing for RE deployment in SA. However, the liquidity of the debt finance market is limited, and new banking regulations are going to place further restrictions on project debt financing. One such example is the introduction of Basel III regulations in 2016, which aims to strengthen bank capital requirements by increasing banks liquidity by ensuring that banks are well capitalized, and thereby decreasing bank leverage in order to avoid another 2007/2008 financial crisis. The new regulation will penalise banks holdings of RE project debt because this form of debt is classified as illiquid (Sager, 2014; BIS, 2014). Because of this, RE financing will be penalised for its long time horizons and level of illiquidity (Sager, 2014).

2.4. Concentrated Solar Power (CSP)

2.4.1. Global CSP Market

CSP is a low-emissions technology that has gained significant international interest over the past five years. It has therefore moved rapidly along the innovation chain from pilot plants to commercial deployment (Tomaschek *et al.*, 2015). It currently makes up less than 0.1% of global electricity installation capacity (IEA, 2012; Stadelmann *et al.*, 2014). Still, several studies, including those conducted by the International Energy Association (IEA), highlighted the growing importance of CSP in future energy generation. The IEA projected that it might possibly supply up to 10% of global energy demand by 2050 (IEA, 2012).

The first CSP plants that were built were in the United States (US) in the mid-80's (Stadelmann *et al.*, 2014). Notwithstanding this, no new projects have been developed anywhere around the world over the past two decades, all as a result of investment stagnation. However, the past five years have seen significant investment and deployment of CSP at utility-scale (Stadelmann *et al.*, 2014). It has been estimated that at the end of 2013, approximately 3340 MW of CSP was installed globally, and that by the end of 2017 more than 8137 MW of CSP capacity will be installed taking into account the current projects under development and construction (Tomaschek *et al.*, 2015).

To date, Spain leads the industry with 70% of globally installed generation capacity, with the US in second place at 21% (Stadelmann *et al.*, 2014). In recent years there has been a shift of focus towards more developing markets, particularly in sunshine-rich countries that wish to exploit their solar thermal resources, ensure energy security and achieve a sustainable growth path (Stadelmann *et al.*, 2014; Frisari and Stadelmann, 2015). Emerging economies and regions that have seen significant investments in CSP include South Africa, India, Chile, China, the Middle East and North Africa (MENA) (Stadelmann *et al.*, 2014; Frisari and Stadelmann, 2015).

2.4.2. CSP Technologies

All CSP plants capture energy from solar radiance, through the use of mirrors and lenses that heat a fluid (heat transfer fluid (HTF)), which in turn is used to produce steam to drive turbines, thereby generate electricity (Viebahn *et al.*, 2011; Stadelmann *et al.*, 2014; Edkins *et al.*, 2009).

To date there are four types of CSP technologies, namely: Parabolic Trough, Linear Fresnel, Power Tower and Dish Stirling (Tomaschek *et al.*, 2015; Stadelmann *et al.*, 2014; Edkins *et al.*, 2009). These four technologies can be further broken-down into two categories: 'line-focusing' systems and 'point-focusing' systems (Stadelmann *et al.*, 2014). The focus of this study is CSP parabolic trough with thermal storage. An explanation of this technology can be found in section 2.5.

2.4.3. CSP in South Africa

SA is currently transforming its energy sector to tackle its energy security concerns and to decarbonise its energy portfolio (Boyd *et al.*, 2014). As a consequence, it has rolled out a number of RE projects to achieve its objectives of adding 20 GW of new RE generation capacity, of which 3.3 GW will be from CSP (Boyd *et al.*, 2014). With that, increasing interest in CSP in SA is largely due to the fact the CSP with large storage capacity can offer a real alternative to baseload coal-fired plants and nuclear plants.

Eight CSP projects are currently being developed or are under construction in SA. SA's REIPPP Programme has been responsible for stimulating investment and for the deployment of seven of these projects (Table 1). In addition, Eskom is currently developing one CSP project with the aim to reach financial close by the end of 2015 (Roberts, 2015; Boyd *et al.*, 2014).

A number of factors have been identified as drivers for the deployment of CSP plants in SA, these include:

- *Solar Thermal Potential:*

SA has one of the world's greatest solar energy resources with a daily direct normal irradiance (DNI) of above 7 KWh/m², which is 40%-50% above Spain's - the world leader in CSP (Pfenninger and Kierstead, 2015). Figure 5 highlights that large areas of SA have an annual sum of DNI of 2600 – 3200 KWh/m².

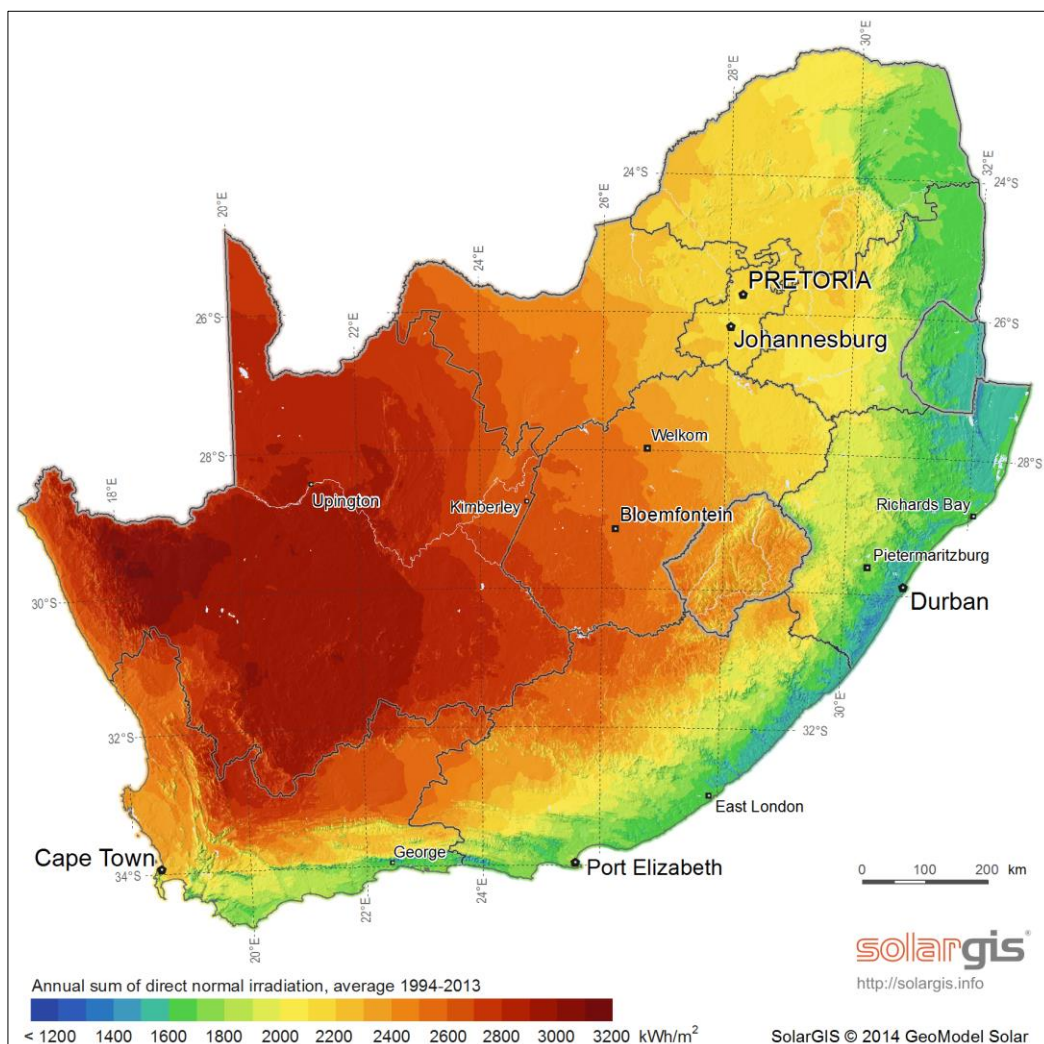


Figure 5: South Africa's Annual Sum of Direct Normal Irradiation

Source: SolarGis (2014)

- *Energy Security:*
CSP is a proven RE technology that can provide non-intermittent electricity generation, thereby improving grid flexibility and stability where it will be able to bridge the gap between demand and supply during peak hours when required, as well as provide energy when there is no sunshine (Viebahn *et al.*, 2011). Other than hydro power (which has potentially high environmental impacts), it is the only large-scale RE technology that is able to satisfy this peak demand profile in SA (Viebahn *et al.*, 2011).
- *Local Added Value (Socio-Economic Benefits):*
SA is plagued by structural challenges such as high unemployment, poverty and inequality (Boyd *et al.*, 2014). Energy and electricity are critical to address these issues. CSP will not only contribute to achieving energy security, but will create employment opportunities and provide skills development (SASTELA *et al.*, 2013). Moreover, CSP deployment will assist in further development of the local RE industry and specifically the CSP manufacturing industry, thereby helping to advocate the further development of local supply chains (Viebahn *et al.*, 2011; Boyd *et al.*, 2014). A less-developed supply side market with a high level of local content allows SA the chance to participate in a meaningful manner in the improvement of supply chains across the country (SolAfrica, 2013).
- *Sustainable Economic Growth:*
CSP has a low environmental impact and will play an important role in decarbonising the energy sector (SASTELA *et al.*, 2013). This, combined with greater economic growth as result of improved energy security, will set SA on a sustainable growth path.

The aforementioned highlights that CSP has the potential to be a catalyst for change in SA. However, deployment in SA faces a number of challenges. Currently, the main barrier to entry in the country is the current cost of CSP (Edkins *et al.*, 2009), whereby the technology requires large upfront capital costs. Moreover, the current LCOE for CSP is higher than both RE and conventional fossil fuel alternatives (Papapetrou, 2014; Pfenninger and Kierstead, 2015). Nevertheless, it is believed that cost reduction may be achieved through increased deployment (capacity extension), research and development, as well as localisation of manufacturing (Eskom, 2013b). Additional challenges/risks that could continue to hinder the adequate implementation of CSP in SA include financial, regulatory and infrastructural risks/challenges (Edkins *et al.*, 2009).

2.5. Project Overview of Bokpoort 50MW CSP Project, South Africa

The Bokpoort 50MW CSP project was awarded 'Preferred Bidder' status in round 2 of REIPPPP in 2012 (Thomson Reuter, 2013). The project is located at Bokpoort farm, which is approximately 20km north of Groblershoop, in the Northern Cape Province of SA (Figure 6). The nearest medium sized town is Upington which is approximately 120 km from the project site (UNFCCC, 2012).



Figure 6: Maps of Project Site

Source: Energy Blog (2015)

This site is ideally suited since a large proportion of the area has a gradient less than 2% and has a sum annual DNI of 2800 kWh/m² (UNFCCC, 2012; SolAfrica, 2013). Furthermore, it is close to a sub-station and has good access to a nearby road network (Thomson Reuter, 2013).

Originally, this plant was designed with a net capacity of 75 MW. However, the REIPPPP request for proposal (RfP) released in August 2011 provided an allocation of 200 MW of CSP. Notwithstanding this, Abengoa Solar was awarded 150 MW of the aforementioned allocation (UNFCCC, 2012). In order to remain compliant, the Bokpoort CSP project reduced its capacity to 50MW (UNFCCC, 2012).

This project will employ a parabolic trough CSP technology (ACWA Power, 2015). Once built, the plant will collect energy from sunrays through an array of solar collectors connected together through heat transfer tubes that carry HTF (Figure 7). The HTF will absorb the collected energy and will transfer this energy to a boiler for steam generation (ACWA Power, 2015; Thomson Reuters, 2013). A 50MW steam turbine will then be driven by the steam to generate electricity. Excess heat will be used to heat a molten salt mix that is stored in large insulated tanks and which will be used to generate electricity after sunset (ACWA Power, 2015; Thomson Reuters, 2013; UNFCCC, 2012). The specific technology used at this plant has a unique thermal storage capacity of 9.3 hours (1300 MWh) (ACWA Power, 2013). The project's technological components and processes are illustrated in Figure 8 below.



Figure 7: Image of the Parabolic Troughs Constructed at Bokpoort CSP Plant

Source: ACWA Power (2015)

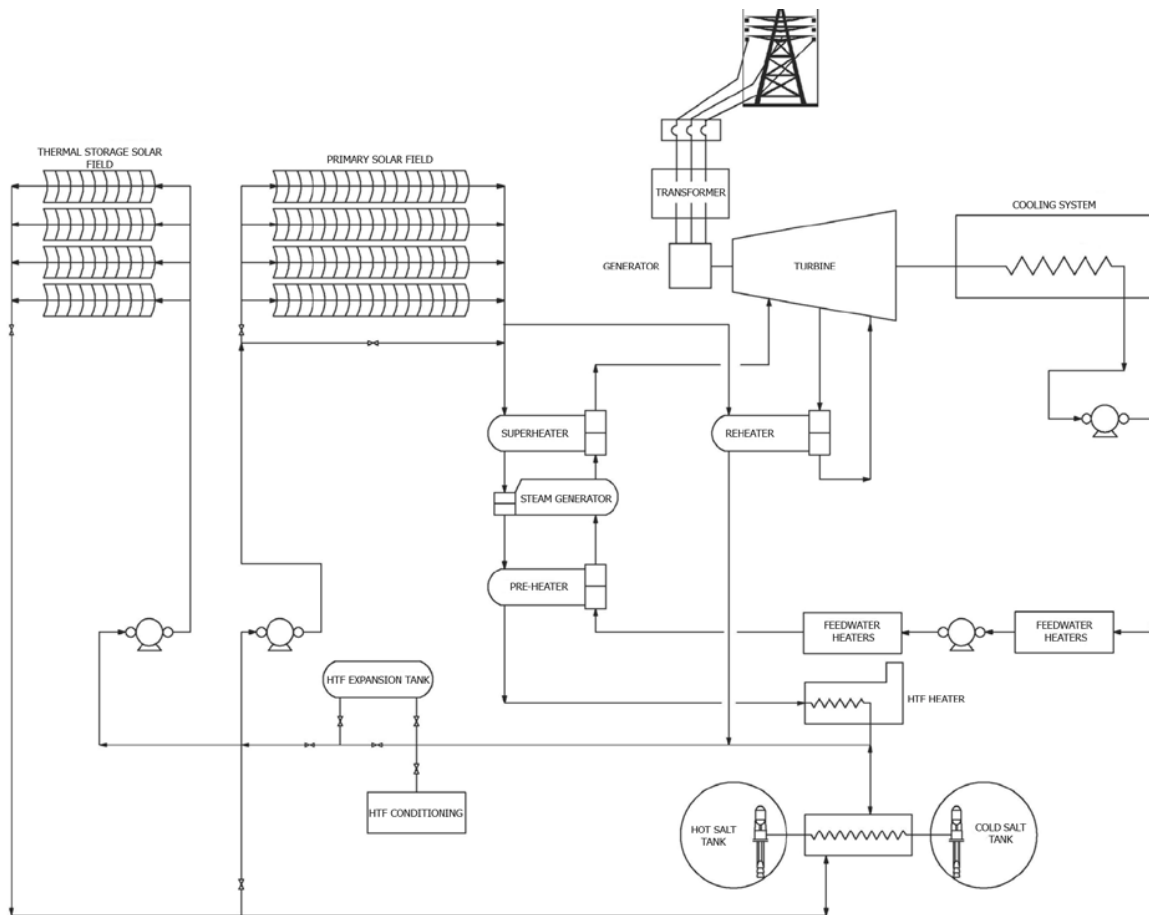


Figure 8: Schematic Diagram of the CSP Process

Source: UNFCCC (2012)

This project is said to be a land mark in REIPPPP due to its large thermal storage feature, the largest in the world for this size of plant. This effectively makes it a baseload power plant (ACWA Power, 2015; Thomson Reuters, 2013). It is also a landmark project due to its economic empowerment funding structure (Thomson Reuters, 2013). The project contains high levels of local content with 40% of capital investments arising domestically (SolAfrica, 2013). Moreover, while equity funding for BEE and BBBEE Shareholders is usually provided by public financial institutions, ACWA Power, the lead project sponsor, came to the fore and decided to provide the equity funding for the BEE shareholder, setting a precedent in REIPPPP projects (Thomson Reuters, 2013). In addition to the project creating employment and investing in local infrastructure, it will significantly contribute to local economic development by providing support to BEE farming initiatives and youth development within communities, which are within a 50km radius from the project site. These communities will receive 0.45% of project revenue (Thomson Reuters, 2013).

2.5.1. Financing Structure

This plant adopted a 'Project Finance' structure, with a debt-to-equity ratio of 71% to 29% respectively (ACWA Power, 2015). Project finance can be defined as "the raising of finance on a limited recourse basis, for the purposes of developing a large capital intensive infrastructure project, where the borrower is a special purpose vehicle and repayment of the financing by the borrower will be dependent on the internally generated cash flows of the project" (Gardner and Wright, 2012). With that in mind, the financing is based on the projected cash flows of the project rather than the balance sheet of the project's sponsor.

2.5.1.1. Debt Financing

Debt financing for the project has been provided by Investec Bank (Investec), ABSA Bank Limited (ABSA) and Old Mutual Specialised Finance (OMSFIN), with Investec and ABSA being the lead arranger and underwriter (Thomson Reuters, 2013). Together they made an underwriting commitment of US\$118 million (R1.3bn). Investec and ABSA made an additional commitment to provide US\$77 million (R850 million) each on a 'take and hold basis' (Thomson Reuters, 2013). This debt was provided for a contractual tenor of 19.5 years (Thomson Reuters, 2013).

2.5.1.2. Equity Financing

The equity funding is provided by ACWA Power, Public Investment Corporation (PIC), Lereko SolAfrica Investments and two Lereko Metier Sustainability funds, namely Lereko Metier SolAfrica Fund (LMSF1) and Lereko Metier Sustainability Capital Fund (LMSCF) (Thomson Reuters, 2013). The Lereko investments and funds make up the BEE equity share of the project, with the equity finance provided by ACWA Power (Thomson Reuters, 2013). Kurisani, an investment arm of the SA non-governmental organisation, Lovelife, and a local community trust, are the BBBEE project partners with the PIC providing the equity financing for the BBBEE partners (Thomson Reuters, 2013). It is therefore evident that the equity financing has been provided in a unique manner made up of both share capital and shareholder loans. Figure 9 below illustrates the project company's structure.

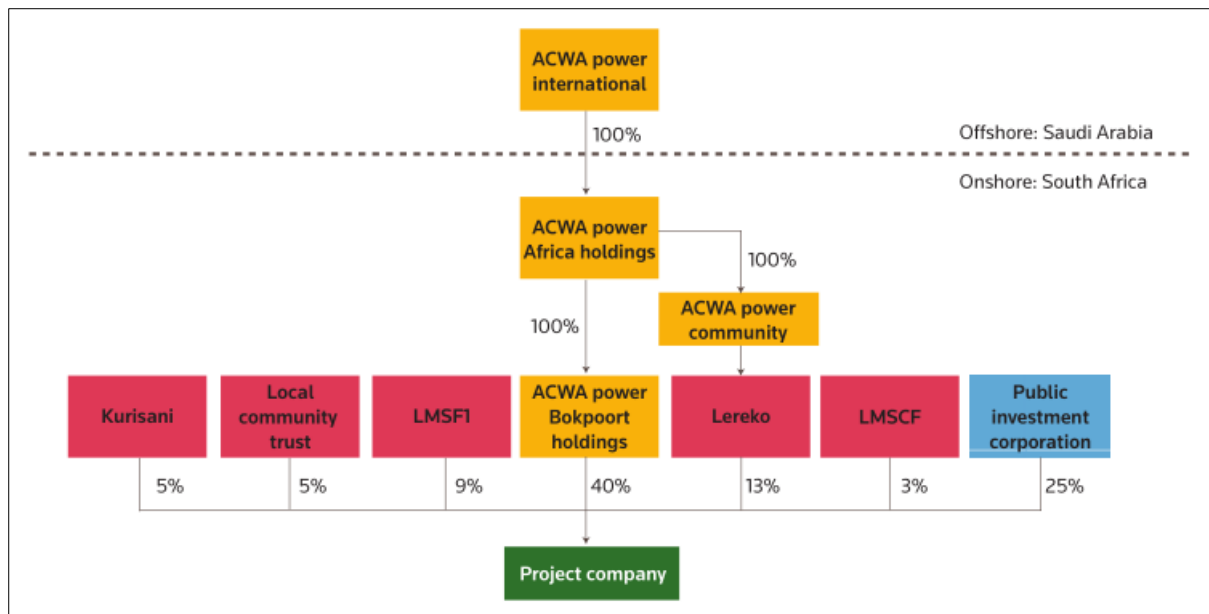


Figure 9: Project Company Structure

Source: Thomson Reuters (2013)

2.5.1.3. Additional Project Participants, Costs and Revenue Streams

2.5.1.3.1. Construction Contractors

The construction of the project is undertaken by an engineering procurement and construction (EPC) consortium, which includes 3 Spanish companies, with experience in developing and constructing CSP plants across the globe, namely TSK Electrónica y Electricidad, Acciona Infraestructuras and Sener Ingeniería y Sistemas (ACWA Power, 2015). South Africa's Crowie Concessions (Pty) Ltd was the fourth party (ACWA Power, 2015).

2.5.1.3.2. Operations and Maintenance

The operations and maintenance (O&M) of the project will be carried out by a joint venture between NOMAC (70%) – which is a wholly owned subsidiary of ACWA Power – and Invest in Africa Energy Services (Pty) Ltd (30%) (ACWA Power, 2015; Thomson Reuters, 2013). Furthermore, it has been arranged for the EPC contractors to provide O&M support for the first 3 years of operation (Thomson Reuters, 2013).

2.5.1.3.3. PPA and the Clean Development Mechanism

The project developers have signed with Eskom for a 20 year PPA (Thomson Reuters, 2013). Eskom's payment obligations are guaranteed by the South African government. The project is accredited under the clean development mechanism, therefore it can gain additional streams of revenue

through the selling of carbon credits to both voluntary and compliant carbon markets. The crediting period for the sale of carbon credits from the project activity is 10 years (UNFCCC, 2012).

A summary of the projects details can be found in Table 4.

Table 4: Project Summary

Sources: ACWA Power (2015), Thomson Reuters (2013) and Boyd et al.,(2014)

Bokpoort CSP Project Overview	
Location	Groblershoop, Northern Cape, SA
Size (MW)	50
Storage (Hours)	9,3
Technology	Parabolic Trough
Net Capacity (MW)	50
Electricity Generation (MWh/yr)	224 000
Households Powered in SA / Year	17 000
Avoided Emissions tCO₂e / Year	200 000
CDM Crediting Period (Years)	10
Project Cost (USD Million)	565
Financing Method	Project Finance
Financing Structure	71% Debt: 29% Equity
Shareholderss	ACWA Power Lereko Investments Lereko Metier Funds PIC Local Community Trust Kurisani
Debt Financers	ABSA Investec OMSFIN
EPC	TSK Electrónica y Electricidad, Acciona Infraestructuras Sener Ingeniería y Sistemas Crowie Concession (Pty) Ltd
O&M	NOMAC Africa Energy Services (Pty) Ltd
PPA (Years)	20

The Bokpoort project reached financial close in 2013 and is currently under construction (Thomson Reuters, 2013). It is expected to start operation at the end of 2015 (ACWA Power, 2015).

3. Methodology

3.1. Mixed Method Research Approach

This study adopted a mixed methods research approach that involves the use of both a quantitative and qualitative method (Johnson *et al.*, 2007). Tashakkori and Creswell (2007: 4) define this mixed method as “research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or programme of inquiry”. Since the overarching aim of this project is to explore the potential of CSP in SA (table 5), this choice of methodology was important considering it provided both breadth and depth of understanding on the research topic. This enhanced understanding was achieved through the use of financial modelling (quantitative research methods approach) whereby a discounted cash flow (DCF) model was developed to explore the financial viability of the Bokpoort 50 MW CSP plant in SA (section 4.3). In addition, this study also conducted formal interviews with a range of stakeholders (qualitative research methods approach) to gain knowledge and insight on their perspectives on SA’s REIPPP Programme, the Bokpoort plant, the risks and challenges facing the plant, and the general deployment of CSP in SA (section 4.2 and 4.7). This research approach was essential to this study, since qualitative data obtained from the stakeholder interviews were embedded in the quantitative approach (financial modelling) – this is a common feature of the mixed method approach (Creswell and Plano Clark, 2010). Consequently, a mixed research method provides a better understanding and assists in answering the projects research question, than having two separate approaches (Creswell and Plano Clark, 2010).

Table 5: The Study’s Research Question, Aims and Objectives

Research Question	What is the potential role of CSP in SA’s renewable energy market?
Aims and Objectives	<p>To demonstrate the market potential of CSP in SA.</p> <p>To assess the financial viability and the risks/challenges associated with the Bokpoort plant (as well as those risks facing CSP generally in SA) by assessing 3 dimensions:</p> <ul style="list-style-type: none">▪ Institutional relationships and the projects financial structure.

	<ul style="list-style-type: none"> ▪ Financial feasibility (discounted cash flow model estimates). ▪ Risk assessment and mitigation measures <p>To identify alternative debt financing mechanisms</p> <p>To provide recommendations for the improvement of REIPPPP</p>
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3.2. Qualitative Research Approach - Interviews

This study conducted formal interviews with a range of stakeholders to explore the potential of CSP in SA. More specifically, it aimed to gain a better insight and understanding of the Bokpoort CSP plant (since limited information was publically available). In addition, the interviews also explored existing and/or potential barriers and opportunities associated with CSP in SA. Thus, this study carefully selected interviewees from a range of sectors and organisations that have been involved in the Bokpoort project and/or in the CSP industry in SA.

After careful selection and consent from the interview candidates, 5 interviewees participated in this study (Table 6). These interviewees covered a range of sectors and institutions, which included financial and research institutions, as well as project developers and non-government organisations (NGOs).

Table 6: Summary of Interview Candidates*Source: Author*

Type	Company/ Organisation	Name	Description
Project Developer	P1. SolAfrica Thermal Energy and Lereko Metier Sustainable Capital Fund(LMSC)	Marc Immerman	<ul style="list-style-type: none"> • Founder and shareholder of SolAfrica Thermal Energy which is one of the project developers of Bokpoort • Principal at LMSC Fund which is one of the shareholders of Bokpoort
Financial Institutions	F1. Barclays Africa Group (also referred to as ABSA Capital)	Bhavtik Vallabhjee	<ul style="list-style-type: none"> • Director of Power, Utilities and Infrastructure. • Was involved in the Bokpoort deal and is a specialist in Project Finance
	F2. Investec	Nicolas Tucker	<ul style="list-style-type: none"> • Consultant in Investec's Power and Infrastructure Finance division. • Lead debt arranger in renewable energy projects that Investec is involved in and is Investec's CSP expert. • Investec was one of the debt financiers of the Bokpoort project
NGO	N1. Southern Africa Solar Thermal Electricity Association (SASTELA)	Ntombikanina Malinga	<ul style="list-style-type: none"> • CEO of SASTELA • SA's Leading organisation that promotes the roll-out of CSP in Southern Africa. • Members include CSP industry leaders ranging from developers to researchers and policy makers
Research Group and Academia	R1. Solar Thermal Energy Research Group (STERG)	Frank Dinter	<ul style="list-style-type: none"> • Head of STERG • Eskom Chair in CSP at Stellenbosch University in SA.

The interviews were conducted either telephonically or over Skype. They ranged from 30 minutes to 1 hour in length. Prior to each interview a number of ethical issues were taken into consideration. These included:

- Fully explaining the research topic to the potential interviewee and clearly disclosing what the information from the interview will be used for.
- Receiving informed consent - This study received informed consent from the participant before they participated in the interview.
- Respecting Individual Autonomy - Even though the interviewee provided written or verbal consent, he/she will still be allowed to withdraw from the study at any given time.
- Maintaining anonymity and confidentiality - Unless given signed permission to disclose certain information (e.g. the participant's identity).
- Prior the interview, all participants gave written and/or verbal consent to be recorded and for the recording to be transcribed (example of consent form in Appendix 1)

A semi-structured interview technique was used that included a combination of both closed and open-ended questions (Kvale, 1996). This approach was chosen because it allowed for both flexibility and structure. With that, the interview questions were used to serve as an outline for discussion, focusing on certain themes and topics, and thereby allowing for comparability between interviewees. It also provided flexibility since it allowed the interviewees to discuss certain topics in more detail if they so wished, as well as any other topics that they believed would be pertinent and of value to the study. Once the interviews were completed, each one was transcribed (Appendix 2).

Following their transcriptions, each interview was analysed by breaking up the transcripts and categorising them into different themes and topics. Further analysis involved identifying similarities, contradictions, gaps and unique findings between the interviewees. These findings were then reviewed and discussed against existing literature on the different categories highlighted.

3.3. Quantitative Research Approach - Discounted Cash Flow Model (DCF)

This study used a DCF model to estimate the financial attractiveness of the Bokpoort project. A DCF model uses future cash flows from the project/company and takes into account the time value of money by using an appropriate discount rate, thus arriving to a present value (Investopedia, 2015). Therefore discounted cash flow evaluations evaluate the intrinsic (true) value of the project.

This section will highlight the key economic indicators that were used in the analysis to assess the financial viability of the Bokpoort CSP plant.

3.3.1. Net Present Value (NPV)

NPV is an important economic indicator and is used to determine the profitability of a project. It can be defined as “the sum of the present values of all the future cash flows (inflows and outflows) for a project” (Martiz and Hibling, 2008). The NPV thus subtracts the present value of cash outflows from the present value of cash inflows.

NPV can be calculated using the following formula:

$$NPV = \sum_{t=1}^T \frac{C_t}{(1+r)^t} - C_0$$

Equation 1

Where:

C_t = the net cash inflow during period t

C_0 = total initial investment costs

r = discount rate

t = number of time periods

The discount rate is an important input value in calculating the NPV, since it does not only take into account the time value of money but all the risk or uncertainty of future cash flows (Richert *et al.*, 2012). Consequently, the discount rate varies greatly (6% to 13%) depending on the CSP technology and the location of the project (SBC Energy Institute, 2013).

Given that projects have different capital structures, the weighted average cost of capital (WACC) is often used as the discount rate (Richert *et al.*, 2012), where it can be calculated as follows:

$$r = WACC = (1-d) \times r_e + d \times r_d$$

Equation 2

where:

d = debt fraction

r_e = required rate of return on equity

r_d = is the interest paid on debt

This study assumed that this project had a debt to equity ratio of 71:29, and assumed it had a discount rate of 8% (Appendix 3).

More importantly, a positive NPV (more than 0) will indicate that the project is profitable and is thus a good investment, since it ultimately informs the investor the project earnings will exceed the projects costs over the projects lifetime (Maritz and Hibling, 2008)

3.3.2. Internal Rate of Return (IRR)

IRR is one of the most common financial indicators used by investors to decide between projects where the project with the highest IRR would be the most attractive to investors (Maritz and Hibling, 2008). Maritz and Hibling (2008) explain the IRR as the as “the discount rate used to make the NPV exactly zero”. The general rule of thumb is that if IRR exceeds the discount rate then the investor should proceed with the project (Thomson and Green, 1998).

3.3.3. Levelized Cost of Electricity (LCOE)

LCOE is the most common tool used to compare different power generation technologies since it does not solely rely on the costs of technologies/projects, but also resources and physical assets (Richert *et al.*, 2012; US EIA, 2015). Vasudev (2011:1) describes LCOE as “a ‘break-even’ value that a power provider would need to charge in order to justify an investment in a particular energy project.

The LCOE of the Bokpoort CSP technology will be calculated as follows:

$$LCOE = \frac{NPV \text{ of } CCF}{NPV \text{ of } EG}$$

Equation 3

Where:

CCF = cost cash flow

EG = total electricity generation

3.3.4. Sensitivity Analysis

A variety of key elements determine the LCOE of a CSP plant, namely: Investment costs, capacity factor, DNI, lifetime of the plant, O&M and discount rate (IEA-ETSAP and IRENA, 2013). With that, this study will conduct a sensitivity analysis to determine the effect of a change of certain financial parameters. These parameters will include the discount rate and investment costs, and how they can affect the financial viability of the Bokpoort plant. These two were specifically chosen since literature has highlighted that they are those that govern the LCOE of CSP technologies (Richert *et al.*, 2012; SBC Energy Institute, 2013). This study also evaluated the effects of a reduction in capital costs and changes to the discount rate on the LCOE of the Bokpoort plant.

3.3.4.1. Overall Capital Cost Reduction

CSP is characterised by high upfront investment costs, especially compared to conventional technologies (IEA-ETSAP and IRENA, 2013). However, literature has indicated that there is great potential for a reduction of these costs as a result of greater deployment of CSP. There is also the additional benefit of high learning rates, where costs are expected to fall between 17% to 40% for parabolic trough technologies by 2020 (SBC Energy Institute, 2013; IRENA, 2012). This study will assess the effects of such reductions on the LCOE of the Bokpoort CSP plant under the following cost reduction ranges (Table 7):

Table 7: Capital Cost Reductions Used in the Sensitivity Analysis

Capital Cost Reductions Used in the Sensitivity Analysis	
Lower Boundary	17 %
Upper Boundary	40%

Source: SBC Energy Institute (2013); IRENA (2012)

3.3.4.2. Discount Rate

As mentioned in section 3.3.1, the discount rate for CSP has a large range of 6% to 13%. This is largely attributed to the maturity of the technology and therefore the risks associated with it (SBC Energy Institute, 2013). Because of this, this study will assess the effects of different discount rates on the LCOE of the Bokpoort plant (Table 8):

Table 8: Discount Rates Used in the Sensitivity Analysis

Discount Rates Used in the Sensitivity Analysis	
Discount Rate (Current)	8%
Discount Rate (Lower Boundary)	6%
Discount Rate (Upper Boundary)	13%

Source: SBC Energy Institute (2013)

Assessing the effects of different discount rates on the LCOE of the Bokpoort plant will demonstrate the effect of risk perceptions on the economics of a technology.

3.4. Limitations

3.4.1. Qualitative Research Approach – Interviews

The information gathered from the 5 interviews was inherently limited due to the following:

- Biases related to the views of the interviewee, which had the capacity to skew his or her thoughts and/or comments so that they would favour his or her ultimate desire. Moreover, the interviewee may not have necessarily expressed his/her personal views but rather that of the organisation that they are part of.
- Some interviewees offer insights from only one camp, or side of stakeholders. Rarely can they offer insights and viewpoints from stakeholders that remain opposite to them. This can lead to a lack of a holistic view when it comes to the overall picture at hand.
- Interviewees were reluctant to share certain information due to confidentiality, such as debt to equity ratio of the Bokpoort plant.
- The 5 interviewees did not accurately represent all the key industry players, as SA governmental departments were unable to participate in this study.

3.4.2. Quantitative Research Approach – Discounted Cash Flow Model

Limitations with the DCF mostly were due to lack of available data on the Bokpoort plant. Consequently a number of assumptions were made (Appendix 3). Moreover, the LCOE was the main economic indicator used to compare the financial viability of CSP with other power technologies, however, the LCOE does not accurately reflect the positive externalities of CSP such as grid stability and a positive environmental impact (Vasudev, 2011).

4. Findings and Discussion

This chapter will discuss the key findings from the interviews as well as the economic indicators obtained for the financial feasibility model. From the analysis, this study has identified 7 main themes that were in keeping with the main aims of this study. These themes include: the importance of CSP in SA, Bokpoort 50 MW CSP Plant, the Financial Viability of CSP in SA, REIPPPP, Eskom as the Single Off-taker, Project Debt Financing, and CSP Risks and Mitigation Strategies. These themes will be discussed against existing literature on the topics.

4.1. The Importance of CSP in SA

One of the aims of this study was to better understand the value of CSP in SA. All 5 interviewees expressed their views on this topic, with each of them highlighting that CSP in SA has a number of different benefits. These benefits include SA's solar resource, dispatchability and grid stability, as well as socio-economic benefits and low environmental impacts.

4.1.1. Solar Resource

One of the main reasons and greatest potential for CSP in SA is its abundant solar resources. This was articulated by three of the interviewees who stated that:

"SA is one of the best sunspots on earth. If we cannot make it here with CSP, we probably cannot make it anywhere" (R1)

"The solar resource here is remarkable. It is on par with the Mojave Desert in America, which is one of the best places in the world for CSP. So from that perspective there is an inherent advantage for the country" (P1)

"I think the writing is on the wall, SA is a really key player, not only regionally but also across the whole continent, and globally. Not only are we bestowed with the best solar resource in the world, we are the top I think, but the statistics and all of the studies tells us that the future is in renewable energy" (N1)

The DNI in SA is high, indicating that a majority of the country has an annual sum of DNI that is in excess of 2100 kWh/m². This is especially true when it comes to the Northern Cape, where the annual sum of DNI reaches approximately 2800 kWh/m² (Figure 5). This makes SA one of the most

attractive countries for CSP in the world (SASTELA *et al.*, 2013; Gauche *et al.*, 2013). Table 9 compares the annual sum of DNI of the top 7 solar resource endowed countries.

Table 9: Average Annual Sum of DNI for the Top 7 Solar Resource Rich Countries *Source: SASTELA et al, (2013)*

Country	Average annual sum of DNI
Italy	2000 kWh/m ²
Spain / Portugal	2200 kWh/m ²
Tunisia	2400 kWh/m ²
U.S. (Nevada)	2500 kWh/m ²
Saudi Arabia	2500 kWh/m ²
South Africa	2800 kWh/m ²
Chile	2900 kWh/m ²

The DNI is an essential aspect since it influences and impacts on both the design and performance of a CSP plant. This is because a high DNI is important for achieving high capacity factors, which could correct any losses that may result from high temperatures - hence the need for a dry cooling systems (SASTELA *et al.*, 2013; PV-Inside, 2013). With that in mind, SA holds a considerable advantage and unique opportunity to make use of this natural resource and to use CSP as part of its national energy mix.

4.1.2. Dispatchability and Grid Stability

Intermittent energy sources, such as solar PV and onshore wind, present a threat to grid system operator planning, which aims to maintain reliability while adequately matching electricity demand and supply (SASTELA *et al.*, 2013; Sager 2014). Moreover, the predictability of RE is often low and the variability of energy output is high, since these energy sources largely depend on weather patterns (Sager, 2014). This can often lead to dispatchability issues since electricity demand might not be met.

Still, dispatchability issues can be minimised with the deployment of thermal energy storage technologies which are attached to RE plants. Therefore, one of the values of CSP in SA is in dispatchability. This is because CSP with thermal storage is a commercially proven technology that can be used to provide electricity on demand, especially when there is no sunshine (IEA-ETSAP and IRENA, 2013; Sager, 2014). This advantage of CSP was highlighted by two interviewees who stated:

“... it’s [CSP] the best large-scale renewable technology you can get and it is dispatchable because you have storage systems, and it’s proven that CSP plants can deliver 24 hours a day. That has been

proven plenty of times in Spain and other countries. And so I really believe that here in SA, CSP has the best chance to step into electricity production at a large-scale” (R1).

“...the peak draw of CSP, is that it is the only renewable that is dispatchable in a commercially proven manner” (P1).

Moreover, not only can thermal storage improve the dispatchability of CSP, but it can also significantly increase the capacity factor of CSP as well as promote grid integration and stability (IEA-ETSAP and IRENA, 2013). This additional benefit of grid stability was highlighted by two interviewees who stated that:

“...a lot of the other renewable solutions disturb the grid quite a bit and we have been working a lot on grid connectivity and how to ensure stability, and CSP has proved to be the least disruptive” (N1).

“I still believe that if the DoE would understand better what CSP can do for grid stabilisation and for energy production, they probably would require different supply schedules and with this they really can perform much better for the grid and for the demand for electricity in SA. I think it’s just a lack of knowledge at the DoE...” (R1).

As a consequence, the benefits that CSP (with thermal storage) provides to the grid, is of great value to the systems operator as well as addressing the gaps between electricity demand and supply. It makes CSP an ideal complement to support intermittent resources, such as solar PV and wind, and provides significant value to the national utility Eskom.

4.1.3. Socio-Economic Benefits

All 5 interviewees acknowledged the socio-economic benefits associated with CSP. These benefits included employment, provision of infrastructure as well as skills and learning centres for local communities (interviewee N1)

In addition, investment in CSP and associated infrastructure is an important source of foreign direct investment for SA (Sager *et al.*, 2015)

Thus, the high localisation potential of CSP as well as its contribution to energy security will contribute significantly SA’s economic development.

4.1.4. Low Environmental Impact

SA's electricity sector is carbon-intensive with coal-fired power plants accounting for 90% of electricity generation (Eberhard *et al.*, 2014; Baker, 2011). CSP will not only contribute to a sustainable growth path for SA by providing energy security, but it will also assist in decarbonising the electricity sector. The aforementioned was touched-upon by interviewee R1:

"You have a lot of coal-fired power stations, where lots of jobs are related to coal-fired plants and mining, but on the other hand, if you look at carbon emission and air pollution and something like this you really have to think about using renewable energies in the future" (R1).

A study conducted by ERC (2011) highlighted the GHG mitigation potential of CSP plants, where the GHG emissions were measured during the lifecycle of a CSP plant and a coal fired plant in SA. The findings noted that the GHG emissions of the CSP plant were approximately 13.8g/kWh_{el} compared to the GHG emissions associated with a conventional coal-fired plant, which were approximately 978g/kWh_{el} (ERC, 2011; SASTELA *et al.*, 2013).

In addition to the GHG mitigation potential of CSP, it has added environmental benefits as opposed to alternative RE technologies and conventional fossil fuel energy plants. These include reduced impact on land and water use, since CSP's land use - in terms of surface area – is significantly below alternative RE technologies such as solar PV and onshore wind (Table 10) (SASTELA *et al.*, 2013; EASAC, 2011).

Table 10: Estimated Land Use of Different Renewable Energy Technologies Source: Trieb (2005); EASAC (2011); SASTELA *et al.*, (2013).

Technology	Land use (km ² /(TWh/y))
CSP	8 - 10
Photovoltaic	10 - 15
Wind (onshore)	up to 41

Furthermore, when it comes to water use, SA is a water scarce country. Therefore CSP with a dry cooling system is most suitable for the country. Interviewee N1 highlighted the water saving potential of CSP by stating that it is *"not going to use much water, the amount of water that will be used will be for the washing of the mirrors. So it doesn't make sense at a number of levels why the excitement is so poor from our government"*.

Thus, given the fact that SA is a water scarce country and that it has made an international commitment at the Copenhagen COP in 2009 to reduce its CO₂ emissions by 34% below the

business-as-usual scenario by 2020, and below 42% by 2025, CSP can play an important role in stimulating a sustainable growth path for the country (Papapetrou, 2014; Baker and Wlokas, 2014).

4.2. Bokpoort 50 MW CSP Plant

The Bokpoort 50 MW CSP Plant is a project that is located at Bokpoort farm, which is approximately 20 km north of Groblershoop, in the Northern Cape Province of SA. This project was awarded 'Preferred Bidder' status in round 2 of REIPPPP in 2012 (Thomson Reuter, 2013). This study used the Bokpoort 50 MW CSP project as a case study to gain better insight on the importance of this specific CSP plant in REIPPPP, as well as to assess any challenges this project experienced. This study also used this specific CSP project as a case study to determine the financial viability of CSP in SA, which will be discussed in section 4.3.

4.2.1. Bokpoort CSP Project – A Landmark in REIPPPP

The Bokpoort CSP project has been viewed as a 'landmark in REIPPPP' and won the *African Renewable Deal of the Year* at the 2013 Thomson Reuters Project Finance International (PFI) Awards (Thomson Reuter, 2013; Barclays Africa Group, 2015). One of the aims of the interviews and this study was to better understand what made this project so unique and/or significant. Interviewees highlighted that the most unique and significant features of this project was its large solar thermal storage (9.3 hours) and its economic empowerment funding structure.

These two features were underscored by the project developer (P1), who stated that:

"The one area that is unique is the storage size relative to the nameplate [capacity]. But the other one that the project has done really well, which has gotten the award for community renewable project, I think that is what you are referring to. And there the board took a decision to distribute some early economic development and social enterprise development funding to the local community to install things like solar PV with battery solutions in shacks. There was a water articulation project and also some scholarships at the local technikon. So the amount dispersed wasn't enormous relative to the size of the project. The size of the project is about R1 billion, but nonetheless because we were able to disperse early and the community didn't have to wait for the construction to end and the start of operation, I think it created a strong favour with the community and I think that this is the one that has gotten this wayward "(P1).

Interviewee P1 emphasised that distributing benefits to the local community early on in the project, played an important role in securing local community support and 'buy-in' for the project:

“...if you look at this project the community was involved even before the bid opened. For the project we did community studies, so the community gets a sniff of something big happening, and then the project breaks, a year later it gets to financial close, and then it will take between 12 and 36 months to build and then still a year to develop the first bucks before anything comes to the community. So there have been some issues with the other projects, so a decision was made to do this as a gesture of good faith and to get the buy in of the community and municipality”(P1).

Interviewee P1 also noted that although this project does have the largest solar thermal storage for a 50 MW parabolic trough plant, it's not the largest storage on a relative basis. Moreover, interviewee P1 also emphasised that the choice of storage size was “purely one of economics”:

“ [...] the decision to have the amount of storage that we ultimately ended up with was purely one of economics. It was one that made the tariff more competitive given the configuration of the plant. So there was no pre-determined strategy to maximise solar thermal storage” (P1)

In addition, REIPPPP's ED component forces the IPP's to engage with local communities within a 50 km radius from the project site. One of the requirements of the ED obligations is that the local communities must receive a certain percentage of the project's revenues. The DoE stipulated that the local community would receive 0,45% of the Bokpoort project's revenue (UNFCCC, 2012).

Interviewee F1 noted that with regards to the projects ED obligations, this project “did go pretty aggressive”. But in addition to this projects unique solar thermal storage and economic empowerment funding structure, interviewee F1 also highlighted that it had an “elite sponsor”, which was ACWA Power, a Saudi Arabian based company. Therefore, this project was also unique since it was this company's first project based in Sub-Saharan Africa. In addition to this, another unusual aspect was that 70% of this project's O&M was carried out by NOMAC - a wholly owned subsidiary of ACWA Power – who specialises in the O&M of gas turbines simple and combined cycle power plants as well as diesel engine power plants with no experience with renewable energy technologies (Interviewee F1; ACWA Power, 2015).

As a consequence of the lack of project experience ACWA Power had in SA and the inexperience of NOMAC in the O&M of renewable energy technologies, the Bokpoort plant had the odds stacked against it from the start.

4.2.2. Project Barriers/Challenges

To date, the Bokpoort 50 MW CSP plant has faced a number of challenges. The interviewees highlighted 3 specific challenges, including: regulatory and licencing challenges, financial challenges, and construction challenges.

4.2.2.1. Regulatory and Licencing Challenges

In order for an IPP to participate in the REIPPP bidding rounds, there are a number of SA government departments and agencies that these projects need to obtain permits and licences from. These include the DoE, South African Heritage Resources Agency, the DEA, The Department of Trade and Industry, the Department of Economic Development, Department of Water Affairs, NERSA and Eskom (DoE,2013).

Literature has indicated that obtaining these licences and permits is often a time consuming and expensive process. The cost of submitting a compliant bid to run can cost approximately R20 -50 million (US\$ 1,8 – 4.5 million) (SolAfrica, 2013; Baker *et al.*, 2015). Interviewees highlighted that the Bokpoort plant faced a few regulatory and licensing hurdles, which were largely attributed to the lack of communication and co-ordination between the national and provincial governmental departments, agencies and Eskom. The aforementioned was noted in an interview with interviewee P1:

“There were lots of challenges. We were quite early to market so quite often various departments weren’t aware of the programme, so we had to convince them to operate against timeframes and deadlines that we needed to achieve, but in the end it came together quite nicely and the support was promising but there certainly were challenges and lots of them”.

He went on to underscore that:

“...there wasn’t good communication between the departments, certainly for the earlier stages”(P1).

Interviewee F1 continued to explained that one of the challenges that this project faced, and which resulted in time-delays outside of the sponsor’s control, was securing PPA’s from Eskom’s single buyer office (SBO). Interviewee F1 said that this delay was largely because *“Eskom has had a few financial challenges, so there had to be certain approvals that had to come from government for Eskom’s obligations etc., and those dragged on a bit and hence, projects didn’t necessarily achieve financial closure in the 6 months stipulated but dragged on slightly over that”.*

This lack of communication and co-ordination between governmental departments and at different levels of government was described by interviewee N1 as *“a nightmare”*. However, these regulatory and licencing challenges could largely be attributed to the fact that this project was new to the market where it was only the second CSP plant in the country and was awarded early on in REIPPP during the 2nd bidding round.

4.2.2.2. Financial Challenges

This project required a large initial investment of approximately US\$ 565 million, and once it was announced *“preferred bidder”* in round 2 of REIPPPP in 2012, it was required to meet financial close by June 2013 (ACWA Power, 2015; Reuters, 2013). Since REIPPPP was a fairly new programme and CSP a new technology in SA - Bokpoort being the country's second utility-scale CSP plant - the domestic financial industry were naturally cautious about getting involved. Moreover, given the large upfront investment needed for this project, it required a variety of equity and debt funders.

Interviewee P1 highlighted that in the run up to financial closure, a key lender and shareholder who withdrew from the project caused them to *“be replaced which was very stressful”*. The shareholder that pulled out was Industrial Development Corporation (IDC), which had an equity stake of 25% in the project and provided BEE empowerment funding of 13% (Reuters, 2013). Another major setback to the project was the departure of the Development Bank of Southern Africa (DBSA) from the deal. The DBSA was providing 50% of the debt funding required (Reuters, 2013). Due to these unforeseen circumstances, the project faced the challenge of bridging the gap in both equity and debt financing.

Fortunately, the PIC stepped into the deal by providing the 25% equity shareholding which was needed, and ACWA Power stepped in and provided the 13% BEE empowerment funding from its own balance sheet – ACWA Power's commitment to this project by providing additional funding created some sort of precedent in REIPPPP (Reuters, 2013).

Trying to secure such a large amount of debt finance in such a short period of time would prove to be a Herculean task. This was particularly evident when one considers that CSP was a relatively new technology in the country, held a significant technological risk profile and required substantial credit approval in such a short period of time. These challenges were echoed by interviewee F1 who stated that *“there is always stuff that you need to get your credit committee cross the line with, and as I said it was a new technology, credit had a requirement”* (Reuters, 2013). Fortunately, existing lenders (Investec and ABSA) stepped up to the plate and played a pivotal role by agreeing to underwrite additional debt of R1,3 billion (Reuters, 2013). Despite these lenders significantly filling the debt finance gap, there was still some debt that needed to be financed. ACWA Power showed its

commitment to the project by providing this additional debt through the form of a mezzanine tranche (Reuters, 2013). Described by Investopedia (2015: 1), a mezzanine tranche is a “debt capital that gives the lender the rights to convert to an ownership or equity interest in the company if the loan is not paid back in time and in full”. In essence, making it a hybrid debt and equity financing mechanism.

Despite these financial challenges, the Bokpoort project reached financial close in June 2013.

4.2.2.3. Construction Challenges

There were 3 main construction challenges that the project experienced. These included: The 2014 National Union of Metalworkers of South Africa (NUMSA) strike, language barriers between EPC (Spanish workers) and local labour, and skills shortages (local).

During July 2014, 220 000 members of NUMSA downed tools for a month and went on strike demanding a 12% wage increase (Business Day Live, 2014). This came after a 5 month wage strike by members of the Association of Mineworkers and Construction Union (AMCU) who were platinum minors from major platinum producers. That strike began in January of that year (Reuters, 2014). These two strikes had negative spill over effects into the economy, which resulted in a global reduction of both precious metals and steel, and slow domestic economic growth over the first two quarters of 2014 (Reuters, 2014; Business Day Live, 2014).

According to interviewee P1, the main construction challenge that the project experienced was the NUMSA strike, which caused slight delays on the project’s construction.

However, other construction issues experienced during the project included language barriers between the EPC Spanish staff and local labour. According to Interviewee N1, there were “*problems with internationals like Spanish and Italians interacting with the locals*”. In addition to this, interviewee P1 also mentioned that construction was largely dependent on the skills and knowledge on of the Spanish staff on project site. This is because Spain is the world leader in CSP, and because local labour lacked specific skills and expertise needed (SolAfrica, 2013).

4.3. The Financial Viability of CSP

To determine the financial viability of CSP in SA, this study used the Bokpoort 50MW project as a case study whereby a discounted cash flow model was used to determine the financial profitability for this project. The financial indicators obtained are used to serve as a benchmark, thus allowing for

comparisons to be made against current CSP market financial indicators as well as against other technologies.

4.3.1. Discounted Cash Flow Model – Feasibility Study

In order to calculate the Bokpoort projects NPV, IRR and LCOE, a number of financial and non-financial parameters needed to be determined (Table 11). In Appendix 3, a table can be found that provides a full break down of the input values as well as sources and assumptions for these values.

Table 11: Summary of Financial and Non-Financial Parameters Used in the Financial Analysis

Source: Created by Author

Financial Parameters	Value
Debt	71%
Interest paid on debt / year	12%
Equity (Ordinary Shares)	29%
Return on Equity	17%
COSTS	
Total Project Costs (Initial capital) (USD\$ millions)	565
OPEX	
Operation and Maintenance Costs (USD/kWh)	0,03
Insurance (% of Initial capital costs/annum)	0,5%
Additional Costs	
% of annual revenue to flow to local community	0,45%
Decommissioning Costs (% of Initial Capital)	2,5%
Corporate Income Tax Rate on Annual Revenue	28%
REVENUE	
Tariff (USD/kWh)	0,22
CER Futures Price (USD)	0,54
ADDITIONAL INFORMATION	
Discount Rate	8%
Non Financial Parameters	
Hours in a year	8760
Gross Capacity (MW) per turbine	54
Net Capacity (MW) per turbine	50
Electricity Generation (MWh/yr)	224000
Thermal Storage (Hours)	9,3
DNI (kWh/m ²)	2800

Results from the DCF analysis included a project NPV of US\$ 165.82 million (R 1.824 billion), an IRR of 5.48% and an LCOE of US\$ 0.20 (R 2.20) (Table 12).

Table 12: Summary of the Project's Financial Indicators

Source: Author

Project's Financial Indicators	
NPV Project (US\$ Million)	165.82
IRR (%)	5.48
LCOE (US\$ / kWh)	0.20

Table 12 highlights that the project's NPV is positive at US\$ 165.82 million. Thus, according to the rule of a positive NPV, this project can be deemed profitable (Maritz and Hibling, 2008). Moreover, this project has an IRR of 5.48%. Although this is not a high value, it is still positive. Furthermore, the IRR is close to SA's government issued bonds (risk free rate) in 2013 which was 6% (SARB, 2015). This indicates a low risk environment and therefore a relatively safe investment opportunity in the market.

In addition, the Bokpoort CSP project has an LCOE of US\$ 0,20 /kWh (R 2.20 / kWh). The LCOE for this project can be deemed favourable since it is close (below) to the PPA tariff of US\$ 0.22 / kWh (R 2.42 /kWh), which means that this project is receiving more per kWh than it requires for the project to break even. Moreover, the Bokpoort LCOE falls within the estimated range for this technology (parabolic trough with thermal storage) of US\$ 0,19/kWh to US\$ 0.33 /kWh (IRENA, 2012). Although CSP is still more expensive than conventional power plants - such as that from coal-fired power plants which has been estimated to have an LCOE of US\$ 0.06/ kWh (R 0. 66/ kWh) - it is still significantly cheaper than diesel-powered OCGT plants which are currently being used in SA to meet peak electricity demand, where it has an LCOE of US\$ 0.50 / kWh (R 5.5 / kWh) (Gauche *et al.*, 2014).

Despite the costs of CSP being higher than that of coal-fired power plants and nuclear, one needs to bear in mind that the LCOE of these technologies does not reflect the negative externalities of these conventional technologies, namely: air pollution, water consumption and pollution, and other health impacts. A study conducted by Greenpeace (2011) investigated the potential 'hidden costs' of Kusile coal-fired power station in SA which is currently under construction, and it concluded that these negative externalities could lead to costs as high as US\$ 0.17/ kWh (R 1.88/ kWh) – something that needs to be taken into account.

Moreover, interviewee R1 also emphasised the need for the costs of CSP to be compared to newly developed plants of other technologies, specifically for coal-fired power plants where the LCOE of Medupi and Kusile is estimated to be much higher than that of earlier built coal-fired plants in SA.

4.3.1. Sensitivity Analysis

The sensitivity analysis for the discount rate (Table 13) highlighted that changes of the discount rate to 6% and 13% resulted in slight changes in the LCOE to US\$ 0.19 / kWh (R 2.09 /kWh) and US\$ 0.22/ kWh (R 2.42) respectively. Reason for such slight changes include that the discount rate only accounts for a small part of the LCOE formula and no other cash flows change. Moreover, it is evident from table 13 that the IRR did not change, irrespective of the change in discount rate. This is because the IRR is the inherent rate of return on the cash flows, thus since the cash flows aren't changing but the discount is, it will remain exactly the same (Maritz and Hibling, 2008). However, the NPV at the different discount rates highlight that the higher the rate, the lower the NPV (inverse relationship). The NPV for the 13% discount rate is negative (US\$ -59.88 million), thus indicating that at this discount rate the Bokpoort project is not profitable.

Table 13: Results from the Discount Rates Used in the Sensitivity Analysis

Source: Author

Sensitivity Analysis			
Discount Rate	6%	8%	13%
NPV Project (US\$ millions)	314.59	165.82	-59.88
IRR	5.48	5.48	5.48
LCOE (US\$ / kWh)	0.19	0.20	0.22

However, table 14 highlights that cost reductions have significant positive effects on all 3 economic indicators - where greater the costs reduction (i.e. 40%), the better the LCOE, NPV and IRR. Where NPV and IRR increase to US\$ 408.98 million and 13.45% respectively, and the LCOE falls to US\$ 0.17/ kWh (R 1.87 / kWh).

Table 14: Results from Capital Cost Reductions Used in the Sensitivity Analysis

Source: Author

Sensitivity Analysis		
Reductions in Overall Capital Costs	17%	40%
NPV Project (US\$ millions)	269.15	408.95
IRR	8.14	13.45
LCOE (US\$ / kWh)	0.19	0.17

The capital cost reduction sensitivity analysis results are not surprising since CSP does require large upfront investments, and literature highlights that initial capital expenditure (CAPEX) makes up 84% of LCOE (Figure 10) (SBC Energy Institute, 2013):

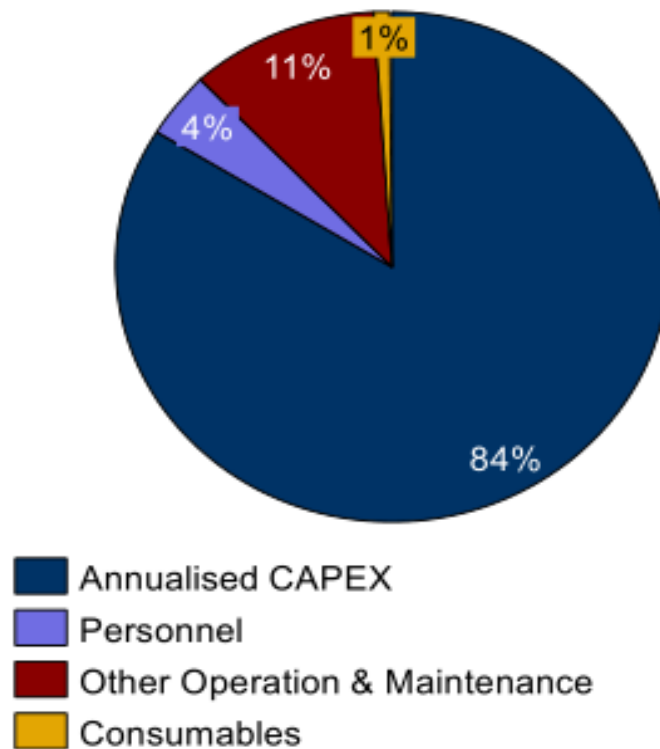


Figure 10: LCOE Breakdown (%)

Source: SBC Energy Institute (2013)

Thus, it is evident from the sensitivity analysis that there is a need to focus on cost reductions in order to make CSP an attractive investment as it will ensure the investors will receive a good return

4.4. REIPPPP

REIPPPP has received much praise and attention by power sector players and investors, both domestically and internationally, for successfully leveraging private capital investments into RE in SA. This is especially true in the context of a nation plagued by an insufficient supply of electricity (power deficit) (Investec, 2014). As highlighted by Baker *et al.*, (2015:1) “in 2014 RE saved the system a total of R800 million in avoided diesel, blackouts and coal costs”. With that, one of the aims of this project and the interviews was to gain the interviewees opinions on REIPPPP as well as to identify areas for improvement.

Most of the interviewees praised REIPPPP. In one instance, interviewee F1 stated that *“the interest [both domestically and internationally] has been phenomenal and that speaks volumes in terms of how the process has been structured and the quality of the RfP that is has been gained through.”* Moreover with regards to RE deployment in SA as a result of REIPPPP, interviewee F1 expressed his satisfaction with the programme by stating that *“it’s not happened at this size or scale in anywhere else in Africa ... It’s still a fabulous feat in a very short period of time. So it speaks volumes in terms of the way the government or the way the DoE have orchestrated this whole programme”*.

Interviewee F2 also praised the design of the programme by describing it as *“incredibly well structured”*. Added to this, interviewee R1 believed that the implementation of the programme was a ‘good idea’:

“I think it’s a good idea to not only let Eskom do it [generate electricity], because Eskom is also a big utility, state-owned and very conservative and has many people. And the independent power producers are smaller companies with fewer overheads, and so they probably can do everything a little bit cheaper than Eskom could do it - and so you get competitors in electricity production. So from my perspective, I think it really makes sense to have a kind of unbundling of grid operation and power production” (R1)

All 5 interviewees highlighted the importance of the CSP plant size, and thus they all praised the DoE for recently increasing maximum contracted capacity for a project utilising CSP technology future bidding rounds from 100MW to 150MW (DoE, 2015). This point was underscored by interviewee P1 where he indicated that *“For CSP in SA, one thing that would help would be the ability to increase the scale of the project, which we [the DoE] have just done. So they have just increased the size from 100 MW to 150 MW.”*

Still, although the programme has received a lot of positive attention, the interviewees did caution that there were still a lot of improvements to be made.

Interviewee N1 critiqued the REIPPPP programme and believed that it was not ambitious enough and that it needed to be reviewed:

“I would say that we haven’t achieved much. For me, I think we could have achieved more. I think we have been very much operating at a mediocre level where we have just done enough where it looks like we have done something globally and everything” (N1).

The interviewees voiced a number of concerns and areas for improvement of REIPPPP, which included the costly and competitive nature of the programme. Interviewee P1 expressed his concern

about the low bid tariffs, mentioning that “*there does seem to be an element of cowboy behaviour seeping into the programme. Where developers are guessing the tariff that they think will win and trying to back themselves after the round. And personally I prefer a concrete programme rather than cowboys taking chances and wining prizes*”. This ‘cowboy behaviour’ could largely be due to the fact that 70% of the project is weighted on price per kWh (DoE, 2015; Sager, 2014). With competition being rife within the bidding rounds, this makes it even more difficult to win the bid (Table 15).

Table 15: Number of Awarded Projects across the 4 Bidding Rounds *Source: Baker et al., (2015)*

Bidding Round	Number of ‘Preferred Bidders’
Round 1	28 of 53
Round 2	19 of 79
Round 3	17 of 93
Round 4	11 of 77

Therefore, due to the increased competition in the bidding rounds, and the fact that 70% of the project is based on the bid tariff of each project, this has resulted in significant tariff decreases across the 4 rounds (Table 16)

Table 16: RE Tariffs across Rounds 1 to 4 *Source: Baker et al., (2015)*

Tariffs	Round 1 average bid (per kWh)	Round 2 average bid (per kWh)	Round 3 average bid (per kWh)	Round 4 average bid (per kWh)
Wind	R 1.14 (\$ 0.10)	R 0.90 (\$ 0.08)	R 0.66 (\$ 0.06)	R 0.62 (\$ 0.06)
Solar PV	R 2.76 (\$ 0.25)	R 1.65 (\$ 0.15)	R 0.88 (\$ 0.08)	R 0.79 (\$ 0.07)
CSP	R 2.69 (\$ 0.25)	R 2.51 (\$ 0.23)	R 1.46 (\$ 0.13)	

*USD/ZAR Exchange Rate = 11

Furthermore, if one takes into account the costs associated with a projects participation in the bidding rounds (R20 – R50 million), it has been estimated that the amount of money lost from unsuccessful bids (risk capital lost) can range between R4,5bn – R11bn (\$ 409 million – \$1 bn) (Baker et al., 2015). To date, there have been 227 unsuccessful bids. Because of this, some would view this scheme as ‘wasteful’ or inefficient one, especially since the country faces extensive structural challenges that need to be urgently addressed.

Another critique of REIPPPP was its allocation of MW among the different RE technologies across the rounds. It has been argued that the programme needs to be more flexible with its allocation, especially for CSP that have been oversubscribed each round (Sager *et al.*, 2015). The need for an increase allocation for CSP was a recommendation made by interviewee N1 for REIPPPP who stated *“allocation, allocation and allocation”*. Reasons for her recommendation were largely due to the fact that SA is one of the best locations in the world for CSP than it is for other technologies – let alone the environmental and socio-economic benefits of technology. With that in mind, it should be awarded more allocation (N1). Interviewee N1 also expressed concern about the ownership of the industry:

“We need to talk about inclusivity, how we get the marginalised people participating, getting South Africans participating, and where is this money going to come from. So who is going to help kick start the diversity of the ownership?”.

She continued: *“For locals today, if you have to start this project on your own and you hope to bid and no guarantee that you’d get the bid, you’d have spent anything between R60-R80million just to work on your submission. So it’s a very costly exercise. I don’t see, maybe one local player, but I don’t see many real local players coming in with their own might. You’d have to have a clever funding plan that is supported by government to see that you get more inclusivity for you, more diverse consortiums that we also share in this ownership of this programme”* (N1).

Thus, due to high competition within the bidding rounds and the high costs associated with participation, the industry is becoming dominated by large international developers (Eberhard *et al.*, 2014). This brings into question the amount of financial returns that is leaving the country.

Lastly, all interviewees indicated that one of the main curtailments of RE generation in SA is the lack of transmission and distribution infrastructure, as well as maintenance. REIPPPP focuses on the power generation side; however, there is currently insufficient investment into the grid and transmission:

“...REIPP energy programme [REIPPPP] is only the generation side. So we haven’t spoken about transmission, we haven’t spoken about distribution” (N1).

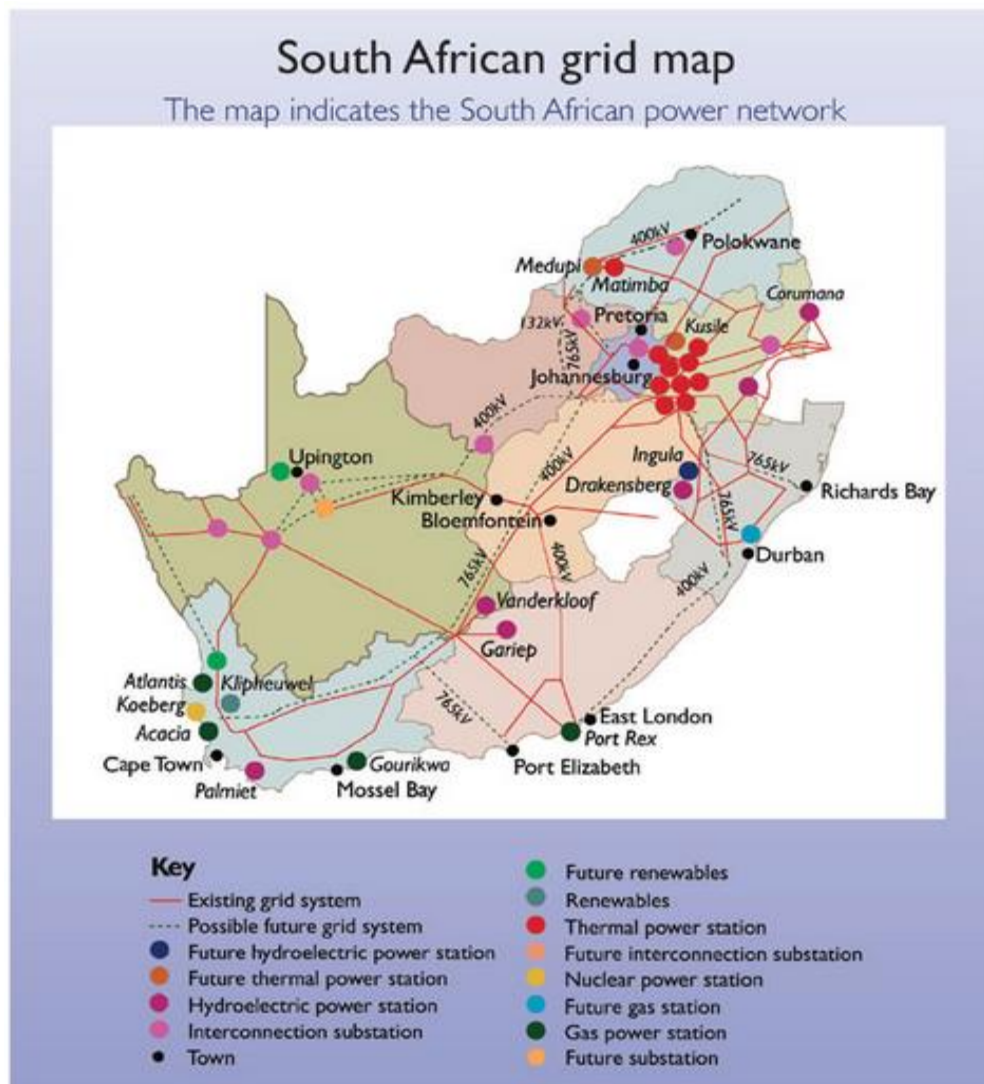


Figure 11: South African Grid Map

Source: Eskom (2015)

The task of upgrading and maintain transmission and distribution is, at present, under the responsibility of Eskom (Eskom, 2015). Yet, the utility company is currently plagued by budgeting and planning challenges, and is struggling with a “*revenue shortfall of up to 225 billion rand (\$21 billion)*” (Reuters, 2014:1). This lack of infrastructure will severely affect the deployment of CSP, especially since most of these plants will be in the Northern Cape. This in an area in SA that holds the highest annual sum of DNI of 2800 kWh/m², making it one of the provinces with the least transmission and distribution infrastructure (Papapetrou, 2014).

Given the high cost of the infrastructure (at least R3 – 4 million/km per line), Eskom’s budgetary problems as well as uncertainty of the location of future RE projects (planning challenges), this poses serious threats to the future of RE in SA – especially CSP (Papapetrou, 2014). However, a study conducted by Gauché *et al*,(2014) offers a possible short-term solution. The solution involves

building CSP plants along a high-capacity voltage line between Cape Town and Johannesburg (Figure 12). Although DNI levels may be lower along this voltage line (annual sum of DNI of 2600 kWh/m²) than in the Northern Cape, it is still high by international standards and will save both time and costs associated with the deployment of the technology in the future, ensuring SA a reliable power generation source (Gauché *et al.*, 2014).

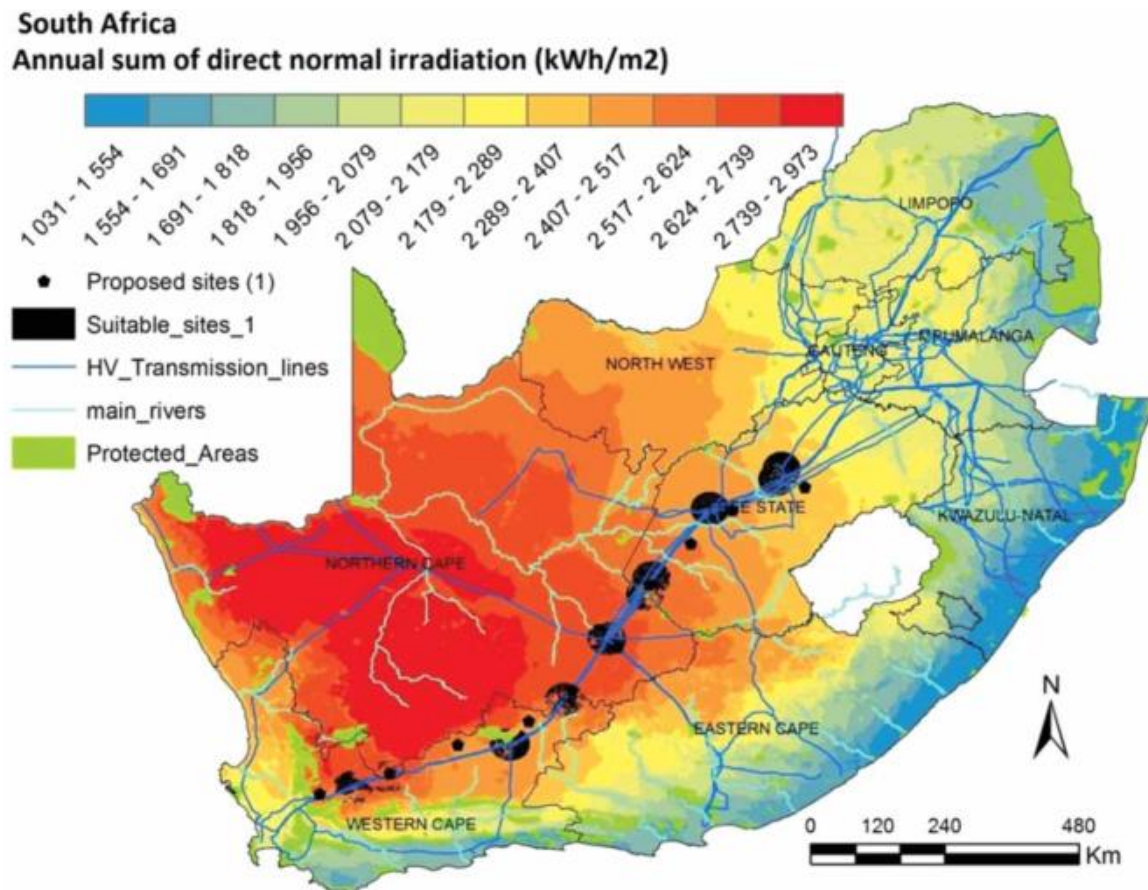


Figure 12: Model locations and Identified Suitable Land for a Short-Term Rollout of CSP Peaking Plants
Source: Gauché *et al.* (2014)

The above discussion highlights that although REIPPPP has provided SA with an important platform for the deployment of RE in SA, it does face many challenges that need to be addressed in order to maintain investor confidence and sponsor interests, also setting SA on a sustainable growth path.

4.5. Eskom as the Single Off-taker

Eskom is the only major utility player in the RE PPA's (Papapetrou, 2014). Yet, to date Eskom has been beset with financial challenges (section 4.4.). Once such example was earlier this year when

Standard and Poor (S&P) downgraded Eskom's credit rating to 'junk' status (Reuters, 2015). This poor rating notifies potential investors of Eskom's inability to repay their loans and therefore acts as a deterrent to future investors, greatly affecting the utility company's financial position. Naturally, this raises the challenge as to whether investors are willing to take a risk on Eskom. One of the key aims of the interviews was to investigate whether the sectors players were concerned about Eskom defaulting on payments. However, all interviews highlighted that this was not of major concern. For example, interviewee P1 stated:

"[...] before we started everyone said that Eskom was never going to allow private power, they never going to sign a bankable PPA - and Eskom certainly were obstructive before this programme for private power - but that seems to have changed now. They were quite supportive in the early stages in terms of grid connection. Remember that the tariff is a pass-through. It's a pass-through system. It goes through NERSA and ultimately to the electricity base. So initially you would have thought they would have been a blockage in the system but in practice it worked" (P1),

This positive sentiment on Eskom was further echoed by interviewee F1:

"Well from the banking fraternity here in SA, there has been a lot of comfort from the financial community, simply because we understand that this is mining territory and Eskom is 100% owned by the national government. So even with financial challenges, it is still has got a lot of muscle and is still the largest utility - in terms of megawatts - in Sub-Saharan Africa or actually in Africa for that matter. It still is generally an effective organisation, and I think the way that the programme was actually structured was that you have Eskom's single buyer office being the off-taker under the PPA, you had an implementation agreement that actually resulted in the DoE standing behind the obligation of Eskom in a default scenario. So ultimately you have the South African Government standing behind its 100% owned subsidiary, and so we had the SA Government standing behind Eskom and the PPA obligation in an event of a default scenario. So worst case, we knew that we were covered " (F1).

Consequently these interviews highlighted that the sovereign guarantees provided to investors by Treasury during a situation in which REIPPPP projects fail is, so far, an essential part of the programme. Without this guarantee, revenue streams based on a PPA's signed with Eskom would be viewed as far more risky (Sager, 2014; Martin and Winkler, 2014).

4.6. Project Debt Financing

Project finance funding method has been the main funding approach for projects in REIPPPP. This is typically because the RE market in SA is relatively new and most RE technologies (such as CSP

technologies) require high initial investments (Papapetrou, 2014). Debt finance typically makes up between 60% - 80% of RE projects in REIPPPP (Baker and Wlokas, 2014). The reason for such high debt proportions on these projects relative to equity is because it is more affordable to fund projects with higher debt than equity (Richert *et al.*, 2012). An equity provider bears most of the project's risks since he or she will receive reduced returns if a project underperform, therefore requiring a risk premium (Richter *et al.*, 2012). In contrast, a debt provider receives fixed interest payments that takes into account the risk of project failure. Despite this, the debt provider does not require an additional premium for under-performance, thereby allowing the debt providers risk premium to be lower (Richter *et al.*, 2012).

In SA, domestic financial institutions have been pivotal to the success of REIPPPP. To date, these institutions have provided 86% of the of debt financing in REIPPPP (Figure 13) (Eberhard *et al.*, 2014)

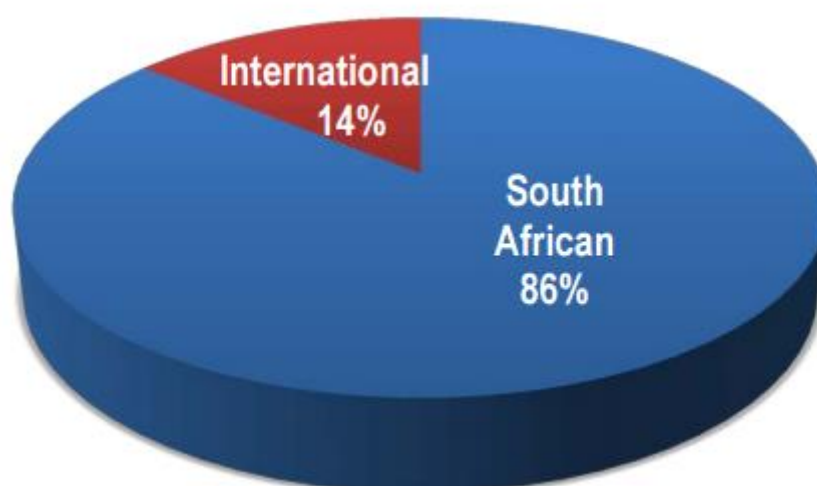


Figure 13: Share of Debt Financing in REIPPPP

Source: Eberhard et al, (2014)

One of the main reasons for such strong participation from domestic financial institutions as highlighted by interviewee F1, is that SA's banks are fairly large by international standards, liquid and are the most sophisticated in Africa (Eberhard *et al.*, 2014). More importantly they have experience in project finance and investing in public infrastructure.

Notwithstanding these factors, there is still a need to widen the debt financing base. All 5 interviewees highlighted that the biggest challenge facing both CSP and other RE technologies in SA is finance – a lack of available finance was underscored as *the* key restraint to RE, especially in the CSP market.

Interviewee F1 emphasised the importance of widening the debt base. The interviewee argued that since a developing country such as SA lacks sufficient public infrastructure, there are a host of other infrastructure and energy projects all competing for financing. Currently, the demand exceeds supply.

All 5 interviewees highlighted that the lack of 'appetite' from internationally based financial institutions in providing debt finance to REIPPPP projects was largely due to foreign exchange risk since it is a "Rand PPA" (F1). In other words, since the PPA is South African Rand denominated, foreign investors are subjected to foreign exchange risk (Papapetrou, 2014). This is especially pertinent when one takes into account that current lenders implement 18 to 20 year debt deals.

This foreign exchange risk exposure was explained by interviewee F2:

"[...] for foreign investors to invest Rands into South Africa; the current lenders are putting 18 to 20 year debt per deal. So if you take construction, which is 2 to 3 years in addition to that, call it 16 years, you are sitting on a 20 year debt deal in Rands. So, for foreign investors to commit 20 year Rands is challenging in itself. Because what they do is take Dollars or Euros, they convert them into Rands and convert the cash from the Rands back into Dollars or Euros [...] So if the Rand devalues and they convert it back, it makes less money so that is a risk that the foreign investors have if they have to commit 20 year debt unless they have sitting on pool of Rands in South Africa that they want to invest." (F2)

An example of this would involve the following:

A foreign investor chooses to invest R1 billion at a current exchange rate of R10/\$. Hence, his investment in US Dollar terms would equate to \$100 million. Should they earn a return of R1.5 billion on the investment (a R500 million profit) that would be substantial unless the Rand weakens to R20/\$. In that case, once the R1.5 billion is converted back into US Dollars at the current exchange rate, it would equate to \$75 million, \$25 million less than the initial \$100 million dollar investment.

Thus, this risk ultimately occurs due as a result of the mismatch between currencies of project revenues and project debt obligations (Eberhard *et al.*, 2014). One of the main reasons for such concern is because SA's currency (Rand) is highly liquid and volatile (Eberhard *et al.*, 2014).



Figure 14: USD/Rand Exchange Rate

Source: OANDA (2015)

Given the import-intensive nature of the RE projects in SA, the weak and volatile Rand could have severe implication on the budgeting of projects (may lead to under budgeting) and also affect the required returns for foreign investors.

4.6.1. Broadening the Debt Base

Given that finance has been identified as one of the main constraints to RE in SA, it is important to seek alternative financing vehicles that could create a diversified group of investors. Therefore, based on the interviews and literature, this study recommends the following options:

4.6.1.1. Debt Refinancing

Debt refinancing usually involves the process of reorganizing ones debt obligations by either replacing the debt, or restructuring the terms of the existing debt. This could involve negotiations between a business and its creditors in order to reduce interest rates, improve covenants, or even extend the terms of the loan(s) (PrivCo, 2015; Sager, 2014; Eberhard *et al.*, 2014)

For a corporation, debt refinancing would usually occur should they be nearing bankruptcy or if interest rates have decreased in the market. The latter would impact on debt repayments since a lower rate would allow the company to cut down on the overall debt that it faces (PrivCo, 2015).

When it comes to renewable energy projects, they have the opportunity to utilise this method in order to benefit from lower interest rates in the market. In a rising interest rate environment, they could use this method to allow for extensions in their loans. Both of these options could yield a more manageable method of dealing with their debt levels without impacting too heavily on the company's/project's operations.

4.6.1.2. Securitization

Securitization involves the process of transforming an illiquid asset (i.e. infrastructure) into a security, thereby making it more liquid. During this process, these illiquid assets can be transformed into debt securities. These types of securities entitle their holder to the payment and interest, while also allowing contractual rights under the terms of the use (Eberhard et al., 2014). They are generally issued over a fixed term and can be protected by either collateral or can be unsecured.

The securitization of this debt has the ability to offer lenders (i.e. banks and other financial institutions) the opportunity to have off most of the debt on their books to third-party lenders. By doing so, they give themselves the chance to free up the debt that they currently hold, allowing them the opportunity to invest in other on-going renewable energy projects in the market. This invariably benefits renewable or low-carbon companies in the market seeing that it offers greater financing options for their projects (Eberhard et al., 2014).

4.6.1.3. Yieldco

A Yieldco is a dividend-oriented special purpose company that aims to offer predictable cash flow, thereby creating a low-risk return investment for investors (Interviewee F1). It will bundle the likes of renewable operating assets in order to offer these predictable cash flows. It generally holds a growth-oriented style. A Yieldco will generally be created by a holding company. In the end, the capital raised can be used to pay off debts or invest in new projects at lower rates.

A key selling point of Yieldco's is their low tax implications (NREL, 2014). Unlike other offerings such as Real Estate Investment Trusts (REITS), Yieldco's can avoid the double-taxation situation that occurs with the former. In other words, rather than having to pay for corporate and shareholder tax, they can pass on the untaxed earnings directly to investors (NREL, 2014). This occurs thanks to the differences between projects' strong cash flows and the losses that occur through the renewable asset depreciation and expenses, often leading to net operating losses.

More often than not, renewable energy projects face a lot uncertainty during the early developmental stages of the project. However they have the ability to produce low risk cash flows once they become fully-fledged operations (NREL, 2014). Because of this, Yieldco have the ability to invest in these projects, thereby unlocking this potential, and offering investors the option of a lower risk investment in renewables – this company serves as a growth vehicle (interviewee F1; NREL, 2014). This, invariably, benefits both the investors and the renewable energy project companies.

Seeing that it is a somewhat new approach to renewable energy investments, it might still flounder, especially in SA where it has never been done before thus there is an issue of first mover advantage (interviewee F1). However, it does provide alternative methods of investments for low-carbon projects.

4.6.1.4. Climate Financing

Another form of investment includes Climate Financing. Similar to the descriptions of ‘infrastructure financing’ that involves investments in infrastructure, climate-financing take into account investments in positive climate changing projects and initiatives (WRI, 2015). This could include renewable energy projects or any others that may help limit GHG emissions and climate change impacts on society (WRI,2015)

This form of financing can either come from a private or public entity. The former being made up of standard investors and project financiers, with the latter being made up of development institutions and governments (WRI, 2015).

In terms of public financing, which could act as an alternative form of investment in this case, it can involve financing by regional, national and international entities (Stadelmann *et al.*, 2014). This would be done with the ultimate aim of creating a transition towards low-carbon, carbon resilient growth and development. It could be described, even more so, as the transfer of funding for climate benefiting purposes from developed to developing countries – like SA.

Many of these are often created as funds that can be attractive for renewable energy projects needing financing. Such examples can include: Least Developed Country Fund, the Special Climate Change Fund, the Green Climate Fund, the Amazon Fund and the Adaptation Fund (UNFCCC, 2014; Guardian, 2013)

Through these channels, alternative methods of financing could be utilised for on-going projects in SA.

4.6.1.5. Retirement Funds and Development Financial Institutions (DFIs)

Institutional investors seek long-term, stable, predictable yields that are not strongly correlated to the market (Sager, 2014). RE projects meet such requirements. In SA, it has been estimated that domestic retirement funds manage R 3 trillion in savings (Sager, 2014). Thus, these funds can be an important source for both debt and equity finance in RE projects.

Moreover, DFI's are a natural option for the funding of RE projects, since they have experience in long-term concessional lending and they have one of their overarching goals is the promotion of sustainable development - RE fits well in this context (Ref). Potential DFI financiers could include the African Development Bank, World Bank, European Investment Bank and KfW (German government-owned development bank) (Baker & McKenzie, 2014).

Importantly, retirement funds and DFI's are also viable options since the Basel III regulation does not apply to them (such as it does for SA's commercial banks) thereby allowing them less restraints on lending (Interviewee F1).

4.7. CSP Risks and Mitigation Measures

CSP technologies in SA, face a number of risks. In addition to financial and foreign exchange risks highlighted in section 4.8, this section will identify risks that face CSP technologies as well as provide risk mitigation strategies (Table 17). These risks came to light during both interviews and literature research.

Table 17: Risk Identification and Mitigation Measures

Risk	Description	Mitigation Measures
Power Market Risk	Uncertainties with regards to market regulations and market outlook, specifically about the future of REIPPPP.	CSP Procurement Programme
Permit Risk	Delays in receiving permits needed in order to participate in REIPPPP bidding rounds. This is due to the complexity of the programme and the lack of capacity of government departments and agencies.	The DoE needs to relax some of the bid requirements in order to simplify the bid application process as well as to reduce time delays and transaction costs.
Resource and Technology Risks	<p>Risks related to solar resource and the technology.</p> <p>These include an inaccurate estimation of the resource which may affect the plants performance, as well as inadequate skilled staff for the construction and operation of the plant – this can adversely affect the construction and operation of the plant.</p>	The South African government should invest more in research and development (R&D) and skills training centres. This should be done to improve resource and technology knowledge and to improve the skills of local workers.
Grid and Transmission Risk	<p>Project developers have faced challenges with regards to grid access and inadequate transmission infrastructure, particularly in the Northern Cape where most of the CSP plants are, since there is limited grid and transmission infrastructure in that region.</p> <p>This has resulted in costly delays in plant construction and</p>	<p>Eskom is currently responsible for grid and transmission infrastructure in SA.</p> <p>Options to improve access to this infrastructure by IPPs include the privatisation of infrastructure, thus allow for project developers to build their own infrastructure.</p> <p>An alternative solution is the</p>

	operation.	<p>proposed Renewable Energy Development Zones by the DoE to government</p> <p>Lastly, for CSP specifically, plants can be built along the an existing high voltage line between Cape Town and Johannesburg as proposed in section 4.4.</p>
Counterparty Risks	<p>Concern surrounds Eskom's credit rating and them defaulting on PPA payments. Concern also surrounding the ability of government to cover PPA payments in the case of default by Eskom.</p>	Privatise the energy sector
Financial Risks	Risks related to the availability of finance for RE projects (specifically CSP).	<p>Refinancing</p> <p>Securitization</p> <p>Yieldco</p> <p>Climate Finance</p> <p>DFI's</p> <p>Retirement Funds</p>
Macro-Economic Risks	Risks related to the macro-economic environment such as currency, inflation and interest rate risks.	<p>Most common tools used to hedge these risks involve the use of financial derivatives such as:</p> <p>Futures</p> <p>Forwards</p> <p>Swaps</p>

Sources: Interviews; Papapetrou (2014); Sager *et al*, (2015)

It is evident from table 17 that some of these risks may be applicable to all RE technologies in SA.

5. Recommendations

The aforementioned discussion has highlighted a number of key challenges that need to be addressed for the improvement of REIPPPP and for the successful deployment of CSP in SA. Taking these challenges into account, this section will provide a number of recommendations for the future deployment of CSP.

Findings from this study have indicated that REIPPPP is plagued by high transaction costs, costly time delays, inflexibility and low procurement MW allocations for CSP in each bidding round. With these issues in mind, this study recommends that the DoE simplifies the REIPPPP bidding requirements thereby reducing transaction costs and permit delays. Alongside this, SA needs to unbundle its national grid and transmission infrastructure and allow for IPP's to build and finance this infrastructure. This will help alleviate financial pressures on the country's Treasury as well as allow for greater MW allocation in each REIPPPP bidding round. This would in turn reduce the number of 'unsuccessful' bidders and prevent the loss of large sums of money associated with bid participation (Section 4.4.).

Furthermore, the interviews and literature have highlighted that one of the biggest factors hindering the deployment of CSP in SA is its high upfront investment costs (Sager *et al.*, 2015). Still, the sensitivity analysis (section 4.3) illustrated that with greater (mass) deployment of CSP plants, capital costs reductions can be achieved and this can have a significant positive affect on the profitability of this technology. Thus, in order for a mass roll-out of CSP to be achieved in SA, this study recommends that the government pursues a CSP fleet procurement programme, similar to the Nuclear Procurement Programme that recently started its procurement process in July 2015 (SA Gov, 2015).

Not only will this CSP procurement enable the scale of deployment that is needed to reduce costs and to provide domestic energy security, but most of these plants would be developed in the Northern Cape which has the highest DNI and is one of SA's most poorest province – a CSP economic zone could be created. As a result, it will also provide the necessary infrastructure and employment opportunities to that region. This procurement will also enable a CSP manufacturing industry to develop since it will provide a pipeline which is necessary for local steel and glass manufactures to get involved (SASTELA *et al.*, 2013). Moreover, such a procurement programme will provide regulatory certainty for CSP, which is pivotal in improving investor confidence.

A development of a CSP manufacturing sector has the potential to make SA a market leader in CSP, a global exporter of key manufactured parts such as the heliostat mirrors, as well as of human capital (skills and Knowledge). In the end, this will give the country a global competitive advantage in the manufacturing industry, which it has been lacking for the past decade (Sager *et al.*, 2015; SASTELA *et al.*, 2015)

6. Conclusion

The aim of this study was to investigate the potential of CSP in SA, where it used the Bokpoort 50 MW CSP plant as a case study. Through an analysis of interviews and literature, this study argues that CSP in SA can provide a variety of environmental and socio-economic benefits. These include reducing CO₂ emissions that can assist the country in meeting its emission reduction goals, support in achieving energy security as well as providing both employment and skills development opportunities. Therefore, CSP can play an important role in advocating a sustainable growth path for SA.

Still, despite the potential of CSP in providing the country with the above-mentioned benefits, through the analysis of the Bokpoort plant, this study highlighted a variety of risks and challenges facing CSP. These included regulatory and licensing challenges, financial challenges and construction challenges. Notwithstanding these, interviewees underscored financial concerns as the main challenge since CSP projects typically require large upfront investment. For example, the Bokpoort plant which required an initial investment of approximately US\$ 565 million. However, despite these challenges, a DCF was used to determine the financial viability of the Bokpoort plant, where the estimated NPV for the project was positive at US\$ 165.82 million. IRR was reasonable at 5.48% and the LCOE was low at US\$ 0.20 / kWh. Although the LCOE for CSP may not be as low as conventional power plants, such as coal-fired power plants (LCOE of US\$ 0.06 / kWh), this study recommends that when comparing the LCOE of different technologies, their associated positive and negative externalities should also be taken into account. In addition, the sensitivity analysis highlighted that capital cost reductions offers the best opportunity to reduce the LCOE of CSP as well as to attract investor interest.

This study also indicated that although REIPPPP has been pivotal in leveraging private capital into RE in SA, while been praised both internationally and domestically, it still has some creases to iron out. For instance, the programme is currently plagued by high transaction costs, costly time delays and critiqued for not being ambitious enough with MW allocation, especially for CSP.

One of the biggest challenges for RE, especially CSP, is obtaining debt finance since the liquidity of the domestic market is limited and due to foreign exchange risk, participation by international financial institutions has been limited.

In light of the aforementioned, this study has recommended that options to broaden the debt finance base include: Debt refinancing, securitization, YieldCo, climate financing, retirement funds

and DFIs. Added to this, this study recommends that REIPPPP simplify its bid requirements, which will reduce transaction costs and time delays. Lastly, this study recommends that government pursues a CSP fleet procurement programme. This will provide manufactures with a pipeline and will ensure that CSP is deployed at scale that is necessary to reduce costs and provide energy security.

Therefore, from this study's analysis on the Bokpoort CSP plant as well as the domestic CSP and RE sector, it can conclude that CSP has great potential in SA while allowing the country the opportunity to become a market leader and exporter of this technology.

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Appendix 1

INFORMED CONSENT FOR INTERVIEWS

The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

I, _____, agree to be interviewed for the project entitled *The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa* which is being produced by Jane Anne Martin, a MSc Carbon Finance student from the University of Edinburgh.

I understand that all information obtained from the interview will be used solely for the purposes of the project. Moreover, I understand that I have the right to say as much or as little as I want on the subject matter, and that I can withdraw from the interview at any moment.

I **agree** to participate in an electronically recorded interview for this project, where the tapes and transcripts will be used solely for project. I understand that these recordings will not be used for any other purpose without me providing written permission.

Signature of Interviewee

Date _____

Appendix 2

Interview Questions and Transcripts

INTERVIEW QUESTIONS

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Marc Immerman

Questions

1. Could you please provide me with a bit of background on yourself, specifically explaining your involvement in the Bokpoort 50MW Concentrated Solar Power (CSP) Project?
2. The Bokpoort CSP project has been viewed as a 'landmark in REIPPP' and won the *African Renewable Deal of the Year* at the 2013 Thomson Reuters Project Finance International (PFI) Awards. What made this project deal so unique and/or significant?
3. What was the debt to equity ratio for the Bokpoort 50 MW plant? Do you believe that this is a sound ratio for a project of this magnitude?
4. What financial challenges did this project face in the run-up to financial closure, if any? And with that, what solutions were put in place to overcome these challenges?
5. What construction challenges did this project experience, if any??
6. What regulatory and/or licencing challenges did this [project experience, if any?

7. Domestic Commercial banks have been the main debt financiers for projects in SA's Renewable Energy Independent Producer Procurement Programme (REIPPPP), so why has there been less 'appetite' from international financial institutions?
8. What do you think is the attraction/appetite for both domestic and international financial institutions in providing debt finance for CSP projects in SA?
9. The nature of financing projects has seen a shift away from *project finance* to *corporate finance* between rounds 1 and 3 of REIPPPP. Why do you believe this shift has occurred?

Do you believe that this trend is likely to persist in the future?

INTERVIEW TRANSCRIPT

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Marc Immerman

Marc: Hello, Jane?

Jane: Hello, Mr. Immerman, how are you?

Marc: Good and you?

Jane: Good, Thanks. Thank you so much for sparing some time today.

Marc: Sure. You can call me Marc.

Jane: Ok, great. Thanks. Sorry there seems to be a bit of a delay on the speaker. Hello?

Marc: Yes?

Jane: Ok, I can hear you clearly. Thank you so much again. And thank you for sending me the consent form earlier this morning.

Marc: Sure.

Jane: Did you by any chance, have a chance to look at the questions I sent you on Friday?

Marc: Briefly, yes.

Jane: Ok, great. Thanks. So for the interview I was planning on working systematically through those questions. But beforehand just to introduce myself and tell you a bit more about the topic.

Marc: Yeah, that will be good.

Jane: Ok, great. So, I'm sure you can hear from the accent, but I am also South African. I actually studied at Rhodes University I did my undergrad there. So after studying I decided I wanted to pursue a career in renewable energy. So that is why I decided to do my master's here in Edinburgh and specializing in Carbon Finance.

Marc: Ok, --

Jane: Hello?

Marc: -- So you are based there in Edinburgh?

Jane: Yes, I am based here in Edinburgh. I have been here for over a year doing my Masters. Which has been an amazing experience. So, I decided to do my Master's thesis just to explore the potential of concentrated solar power in South Africa. And that is when I decided to use the Bokpoort CSP Plant as a case study. Just to demonstrate the mark up potential for concentrated solar power (CSP) and create a financial case for it.

Marc: Ok.

Jane: Yeah, I am hoping from the interview with people such as yourself. And I have contacted one or two individuals from the banks just to find out more about this project and specifically about the financial barriers or all barriers, financial, development construction, that you may have faced and also just recommendations on the project itself.

Marc: Sure.

Jane: Great. I thought we would just start off briefly by you introducing yourself and giving me a bit of background about your project and your involvement in this particular project.

Marc: I'm from Durban originally. I've been here for the last 6 years. I went to DHS, my mother lived in Beria and my father in Umhlanga. I joined Metier about 6 years ago and that was doing two things: to develop the Bokpoort CSP project. So to set-up and work with the housing and partner and a fund focusing on private equity investing in renewables, water efficiency and waste. I qualified with a master's degree in finance from Sydney Australia, New South Wales, and an undergrad at the University of Natal, Maritzburg.

So your first question what is my involvement in Bokpoort? With a colleague of mine called Michael Goldblat we founded the project and did some of the early work to do with the sight identification, the permitting and also some early technology decision. We were very early relative to the market; in fact I think we were the 2nd CSP in the country, which was good and bad in some respects.

We were very involved in the whole development cycle; we chose an ISP2 consortium, which is necessary because of the scale of these projects. And then after that we are also had a shareholder in the project through some of our funds and affiliates.

Jane: Ok, are you part of Leurika Metier or Solar Africa (SA)?

Marc: Both

Jane: You worked in partnership with ACWA Power, is that right?

Marc: Ya, well, so ACWA power joined the project later on. And they were development partner and ultimately and IPP partner in the project.

Jane: And this specific technology used with the high thermal storage capability – how did you come across that specific technology? Were you involved in design, or did ACWA Power bring across that design?

Marc: Well there are 4 different technology types of CSP. So there is trough – which is Bookport. You know about the 4 types?

Jane: Yes, tower, fresnal...

Marc: OK, the decision to have the amount of storage that we ultimately ended up with was purely one of economics. It was one that made the tariff more competitive given the configuration of the plant. So there was no pre-determined strategy to maximise solar thermal storage. On an interest, for its nameplates size, for aMWA, it does have the largest type of storage in the world.

Jane: Is it the largest out of all of the 4 technology options or just for trough? The storage capacity, in other words?

Marc: What do you mean by largest?

Jane: The storage capacity. The over 9 hours...

Marc: For a 50MW plant it does have the most. But it's not on a relative basis. I think that it would probably be chema solar, which is a 20MW tower. I think 12 or 18 hours of storage.

Jane: Ok, great. Thank you. Why do you believe concentrated solar power is so important for SA and has such great potential?

Marc: Couple of reasons: Firstly the solar resource here is remarkable. It is on par with the Magabi desert in America, which are the two best places in the world for CSP. So from that perspective there is an inherent advantage for the country. And I think more specifically is given the demand profile of electricity. So the peak draws CSP is the only renewables that is dispatchable in a commercially proven manner and as a result, CSP is I suppose more value that it would have overseas in the developed maker where your peaks are typically in the midday profile.

Jane: Ok, great. Thank you. Could you tell me a bit about the CSP market in SA? Are any of its components locally manufactured or produced?

Marc: Sure. So at Bookport, we are going to end up with more than 60% local content where something **(wording unclear)** 42%, and you got to remember there is still a very stringent process to get to financial close, the banks are very conservative. So they simply will not allow any newly manufactured mirrors or turbines or anything like that, so its mostly to do with the civil's, the steel concreter etc. Part of the project there are mandated local targets for the project, and I think CSP is about 40 or 50%.

Jane: Sorry, what's that number?

Marc: I'll have a look now. I think it is around 48%.

Jane: 48%, ok. Great. There has been much appraisal about the project (landmark) and most of the comments have been around its economic empowerment funding structure – why is this project so unique and so significant?

Marc: Well it isn't really that unique or significant. The one area that is unique is the storage size relative to the nameplate [capacity]. But the other one that the project has done really well, which has gotten the award for community renewable project, I think that is what you are referring to. And there the board took a decision to distribute some early economic development and social enterprise development funding to the local community to install things like solar PV with battery solutions in shacks. There was a water articulation project and also some scholarships at the local technikon. So the amount dispersed wasn't enormous relative to the size of the project. The size of the project is about R1billion, but nonetheless because we were able to disperse early and the community didn't have to wait for the construction to take a year of operating I think it created a string favour with the community and I think that this is the one that has gotten this wayward.

Jane: Why did you decide to do it early on in the project – was it to secure local community and buy in?

Marc: Yes, but if you look at this projects the community was involved even before the bid began. For the project we did community studies, so the community gets a sniff of something big happening, and then the project breaks, a year later it gets to financial close, and then it will take between 12 and 36 months to build and then still a year to develop the first bucks before anything comes to the community. So there have been some issues with the other projects, so a decision was made to do this as a gesture of good faith and to get the buy in of the community and municipality.

Jane: Yeah, that is clever. Good strategy. Out of interest, I'm not sure if you will be able to disclose this information. But I have read a number of articles and there has been differences on what is being said but do you know off hand what the debt to equity ratio of this project is – about 70% debt, 30% equity?

Marc: I think you are more or less in that level, but I don't want to be too specific due to confidentiality.

Jane: Up to date, has this project experienced any construction challenges thus far?

Marc: I'd say the most serious one has been the strike, so the NUMSA strike, did impact it. Other than that, there haven't been any significant issues encountered, there were one or two smaller issues. We did decide to put nitrogen plant on sight but before that wasn't the intention, but other than that it has more or less gone according to plan. The biggest issue is the strike.

Jane: Yeah, I can imagine so. I have read that a lot of your construction consortium are international, I think there was a few from Spain – was most of your highly skilled staff come from foreign countries and were there any language barriers or cultural conflicts or anything?

Marc: There have been on a broad level, so not really on our project but in Upington there have been some problems with internationals like Spanish and Italians interacting with the locals and getting drunk and misbehaving. So there have been some problems.

Jane: To build a project like this, you need a big labour force, so was the labour locally sourced or and if so did they have the adequate skills for the job?

Marc: Short answer is yes, labour was local. But sure a lot of reliance on the Spaniards, the world leaders in terms of CSP construction.

Jane: And what about regulatory and licensing challenges? From what I have read about the reprogramming there is a lot of documentation you need to secure to even participate in the bidding round. Did you encounter any challenges with that?

Marc: Yes. There were lots of challenges. We were quite early to market so quite often various departments weren't aware of the programme, so we had to convince them to operate against timeframes and deadline that we needed to achieve but in the end it came together quite nicely and the support was promising but there certainly were challenges and lots of them.

Jane: I'm sure it involved quite a few departments, was there good communication and coordination between these departments? And did the departments have the capacity to do the documentation that was needed?

Marc: No there wasn't good communication between the departments, certainly for the earlier stages. But when the rubber hits the road, the Dept. of energy would apply the necessary pressure if it was a dept. that was holding up the project, especially after being nominated as preferred bidders.

Jane: For a project of this scale, it requires a lot of up front capital. Did you have any financial challenges up to financial closure?

Marc: Yes! Many of them. The development funding was a very large ticket. I think it was about R30million to get to financial close. So raising money was pretty difficult given the risks profile. The risk profile and the fact we were going into a new programme. And then after the preferred bid of financial close, we had a lender who withdrew from the project and shareholders who withdrew from the project, so those needed to be replaced which was very stressful.

Jane: I can imagine so. Well obviously you ended up finding a lender but how did you overcome this? Did you just have to approach different shareholders and lenders? Is there anything specifically you did to overcome this?

Marc: Well we had to raise money. You got to remember that the 5 banks are quicker (**wording unclear**) and because it's Rand based (**wording unclear**) your debt has to be Rand based, so it's very difficult.

Jane: To secure financial close did you approach any international financial institutions? To provide any equity or debt finance?

Marc: Yes of course.

Jane: Most of your debt finances are domestic institutions. For what reasons were the international institutions not interested or didn't provide the investment in the end?

Marc: It's the same reasons that I just said, it's because that the debt is Rand based so you can't get freeing denominated debt. And they are very large tickets so unless a bank has a Rand balance sheet, they are not able to lend in Rands. So that's why your universe of debt providers is very, very low.

Jane: This is going to be one of the most difficulties for future South African projects, especially CSP, will it not?

Marc: Everyone thought that was the case. Initially the procured levels were going to be about 3700 MW, which equates to about R100 million. And everyone in the market said where is the money going to come from, and we are e now to R200 millon and it doesn't seem to be slowing down, The banks are interested, there are new entrants coming in on the side. So although you would think it would be a challenge in reality it hasn't actually been that way yet.

Jane: The REIPPPP programme there is a lot of local obligations that it has to adhere to what is your view on them? Because they are quite stringent?

Marc: Look I think its one of the positives of the programme. I think that it has to be verified in order to be checked. I think it's complicated to check and do it properly but the department has set up a division specifically to do this and the penalty of not reporting correctly ad fulfilling the obligations is cancellation of the (PPA) which is an absolute disaster. So I think its positive for the programme and that it will be done properly.

Jane: And with regards to the PPA, did you have any concerns about Eskom being the single off taker? Or any problems securing a PPA with Eskom?

Marc: Before the programme started yes. Yes, before we started everyone said that Eskom was never going to allow private power to put they never going to sign a bankable PPA and Eskom certainly were obstructive before this programme for private power but that seems to have changed now. They were quite supportive in the early stages in terms of grid connection. Remember that the tariff is a pass-through. It's a pass-through system. It goes through NERSA and ultimately to the electricity base. So initially you would of thought they would have been a lockage in the system but in practice it worked.

Jane: Lastly, what recommendations do you have for the improvement of REIPPPP or the future implementation of CSP in SA?

Marc: Ok that's two different questions. For CSP in SA, one thing that would help would be the ability to increase the scale of the project, which we have just done. So they have just

increased the size from 100MW to 150MW. The other thing which is the chicken and egg situation is in order to really stimulate and create a local IP (IP) in the sector we should have line of sight to large scale departments. So for example, DOE, we going to deploy, we going to procure 400MW of CSP every year, I think you will see a lot more uptake.

The sector from the localization perspective is better than from a services perspective. But its very difficult for DOE to do that by the way that the regulatory environment is structured here. There is an integrated resource plan that has to be approved by parliament. So the DOE by themselves can't say by themselves that they will do X, Y and Z. So it's a tricky one. I mean to really get CSP going. And I must qualify that at the moment, SA is the most active CSP market in the world by far. So they definitely are doing something right as to how they could improve it further. I don't think it's so easy, I think going from 100 to 150MW could be positive. There is this solar park which **(wording unclear)** has been looking at, for some time, to try and analyse the technology and increase the localisation, but it's a very complex model when you weight it up against project finance tranches.

Jane: Yeah, ok. And for REIPPPP?

Marc: The programme really has been applauded internationally; it's very cleverly structured. It's a transparent the tariffs have dropped enormously, so much that its beyond anyone's expectations on where they are and it could very well go down so they have recently relayed some of the requirements when it comes to the bidding making it easier to bid but there does seem to be an element of cowboy behaviour seeping into the programme. Where developers are guessing the tariff that they think will win and trying to back themselves after the fact. And personally I prefer a concrete programme rather than cowboys taking chances and wining prizes. I don't there is **(wording unclear)** but I think it's the way it has evolved here.

Jane: But for the LCOE, is there no way that the department checks that to make sure that the value is sound and not just guessed?

Marc: Well you have to remember that the department doesn't face any risk here. If you were to put together a crazy project and managed to compile a **(wording unclear)** bid, which is not that easy you have to put out bidders round, and then if you are a bidder you get a preferred bidder round with is a 100MW, s if you were to do a 140MW, that R14 million on risk, that's only returned if you get to financial close. So even these large numbers haven't been sufficient to deter, the gaming-behaviours of some of the spots. And I just think it's a mature industry now, the developers are aggressive, they know what it takes to win, and I don't think there is any disadvantage to LCOE, I just think it's the market...

Jane: Personally, so many companies/developers enter these bidding round and so few are selected and it's so costly to even apply. There is so much money that is kind of wasted or is it not? Because it costs a lot with lawyers and bankers to get the documentation in place and then you may not win. Or is it just part of the gamble?

Marc: I think you right. It costs an enormous amount of money but they have relaxed their requirements to some extent. And also, when the industry started, the professionals were very cheeky with their requests and then there fees, and that have come down somewhat, but it's still an expensive game to play but these projects are large scale. A 150MW CSP is about R12-R13 billion in total investment. So costs you R20million to bid, is that the end of the world – I think no.

Jane: Yeah, that's true. Considering that the debt finance market. Its fairly limited to the big 4 banks and financial firms. Do you think considering there is quite limited competition, the interest paid on debt do you think it's a bit higher than what it should be?

Marc: I don't think so. I think given south Africa in terms of its inflation rates, in terms of its REPO rate, it terms of the risk margins I don't think that the debt is completely out of its level, all of the foreign **(wording unclear)** when they coming up get a big fright and think that the debt will be overpriced, but when you bring in a denominated edger and they have to swap into Rands, it equates to more or less the same interest rate anyway.

Jane: Ok, thanks. Lastly, are there any other risks that the project faces, or any other comments that you want to make?

Marc: I don't think anything further.

Jane: Ok, great. Thank you. Thanks a lot. Out of interest is there anyone who you would recommend that I could contact from AquaPower to interview?

Marc: Yeah, you can speak with Dandu Bhula, he is the CEO. He might be a bit busy but I can give you his details.

Jane: Ok, great. Thank you. Do you have any resources or anything that you could refer me to look through—of course, I'm sure things are very confidential.

Marc: M: I would just Google this. There is a lot of information online.

Jane: Ok, perfect. Thank you. Thank you so much. Thank you for your time.

Marc: It's a pleasure. You can get a lot of Dandu, his surname is Bhula.

Jane: Ok, perfect.

Marc: You can see his contact details online.

Jane: Thank you so much Mr. Immerman. Thank you again.

Marc:: Bye Jane.

Jane: Bye, chat soon. Let me know if you have any further information on the project or to copy a summary of the findings or anything, ok?

Marc: *[Noise inference]*

Jane: Ok, great bye.

Marc: Bye.

INTERVIEW QUESTIONS

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Bhavtik Vallabhjee

Questions

10. Could you please provide me with a bit of background on yourself, specifically explaining your involvement in the Bokpoort 50MW Concentrated Solar Power (CSP) Project?
11. The Bokpoort CSP project has been viewed as a 'landmark in REIPPP' and won the *African Renewable Deal of the Year* at the 2013 Thomson Reuters Project Finance International (PFI) Awards. What made this project deal so unique and/or significant?
12. What was the debt to equity ratio for the Bokpoort 50 MW plant? Do you believe that this is a sound ratio for a project of this magnitude?
13. What financial challenges did this project face in the run-up to financial closure, if any? And with that, what solutions were put in place to overcome these challenges?
14. Domestic Commercial banks have been the main debt financiers for projects in SA's Renewable Energy Independent Producer Procurement Programme (REIPPPP), so why has there been less 'appetite' from international financial institutions?
15. What do you think is the attraction/appetite for both domestic and international financial institutions in providing debt finance for CSP projects in SA?
16. Do you think that the implementation of Basel III in 2016 will affect the liquidity of commercial banks and thus reduce the provision of debt finance to renewable energy projects in SA?

- 17.** The nature of financing projects has seen a shift away from *project finance* to *corporate finance* between rounds 1 and 3 of REIPPPP. Why do you believe this shift has occurred?

Do you believe that this trend is likely to persist in the future?

- 18.** To broaden the debt financing base, are there any alternative debt financing mechanisms a renewable energy project could consider?

- 19.** Do you have any recommendations for the improvement of REIPPPP and for the future deployment of CSP plants in SA?

INTERVIEW TRANSCRIPT

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Bhavtik Vallabhjee

Jane: Hello Mr. Vallabhjee, How are you?

Bhavtik: Very well thank Jane, how are you keeping?

Jane: Very good thanks. Thank you for taking the time for a discussion today.

Bhavtik: Not a problem at all Jane. Sorry I'm slightly late, but I am all yours for a couple of minutes.

Jane: Thank you.

Bhavtik: Tell me a bit about what you are actually doing, and about your dissertation and what at what stage of your studies etc are you at?

Jane: Ok sure, great. So, I grew up in Durban and I attended Thomas More College. I then completed my undergrad studies at Rhodes University, where I did a Bachelor of Science in Environmental Sciences and my BSc Honours in Economics. I decided afterwards that I wanted to pursue a career in the energy industry or finance, and that's why I decided to pursue a master's at the University of Edinburgh specialising in Carbon Finance. I've spent the past year here in Edinburgh, which has been an amazing experience.

I am currently doing my masters dissertation where I decided to investigate the potential of concentrated solar power (CSP) in South Africa (SA), and particularly to better understand this new renewable energy (RE) programme that has been implemented in SA. The aim is to demonstrate the market potential of CSP in SA, where I have decided to use the Bokpoort CSP plant as a case study to investigate the financial viability of CSP, to investigate the risks and barriers as well as to provide solutions. So that's what I am currently doing.

Bhavtik: Ok fantastic and congratulations. It's lovely to speak to a South African again, which is on the other side of the world. Well done again on your studies and I am quite excited that you have chosen this specific topic.

Fabulous. So to give you a bit of an introduction to myself, I am here at Barclays Capital or at Barclays Africa as we now call ourselves, and I head up head up the Power, utilities and Infrastructure team. My own background is from project financing and the bank, you know we have been extremely active on the South African RE markets. In terms of

megawatts, Barclays has actually supported around something like 42% of megawatts of RE over the past three and half years or the past 4 rounds. This has actually expanded across all various technologies such as wind, solar PV and CSP, and obviously we have looked at a few other things on small hydro, biomass, landfill gas, although are three technologies which we haven't actually funded any of these pursue, typically because they are a bit on the small end for us, but certainty have been very active on CSP for sure. You know we have done Bokpoort which was deal of the year when it closed in round 2 in 2012 and we are looking at a few more in the upcoming round on 1800MW in **(wording unclear)** as they call it here in SA.

But really, thank you, and over to you for the questions. I will try my best to answer them, but obviously there may be stuff, which I may not be able to openly answer because it is primarily confidential.

Jane: Yes I do fully understand.

So, firstly, I wanted to know what your or Barclays involvement in the Bokpoort CSP project was? If you could just please briefly explain on your involvement?

Bhavtik: So Barclays was one of the banks that actually lent into that project. We were actually mandated lead arranger. That deal was a 50 MW CSP trough project, and it closed in 2012 where it was a round 2 deal. We primarily supported that project because of the strong relationship or more the respected sponsor, which was behind it who was actually ACWA Power who I know very well from my days in the Middle East. They are a very strong sponsor where they have about 15 000 MW installed are a very strong developer. So we mostly supported them as a mandated lead arranger on the debt for that particular project.

Jane: Ok great. Has that been the only CSP project that Barclays has been involved in thus far? You mentioned that you are currently looking into a few others, but was this the only project you have been involved in to date?

Bhavtik: There have been 1 or 2 others we have looked at. So we have basically involved in the Kathu project, and that was a project that was developed by GDF Sues, although the name has now changed to ENGIE, it is actually a Belgium entity – a big multinational company where they have something in excess of around 150 000MW installed, so it's a massive utility. We have supported them and that project was successful in the last round 3.5 on CSP, I think that project was a 100 MW project. We have also supported another project called the Emvelo consortium, and that was also trough, but unfortunately that project did not succeed where it bid in the same round as the Kathu project.

So that's what we have done to date, where there has been Bokpoort and Kathu, where Kathu is currently in the process of reaching financial close and where Emvlo didn't succeed. There are also a number of other projects which we are looking at currently for the next upcoming round where I am sure you are aware that the cap on the upcoming projects has been increased from 100 MW to 150MW, so there are currently a number of

developers in SA, internationals actually, looking at putting maximum 150mw projects, and this across both trough and tower, and the is bank generally not 100% comfortable with CSP tower, but with trough we are very comfortable with. Simple reason is that if we look at tower, there are not that many big plants operational with that type of technology around the world at the moment. So there is still very much in its infancy, where with trough there is a few more of that technology operational so the bank is more comfortable with it, with a demonstrational track record with operations. Where I think with tower, whilst the various legs of the technology have been around where most of it is conventional steam generation technology, I think operating at that scale of 100MW for a protracted period has not been in existence and that is the concern we have as a bank.

Jane: Ok that very interesting.

Bhavtik: Typically what you will find is that a lot of the tower CSP projects to date, certainly there has been other projects where Abengoa have a project called Xhi, which was a round 1 project, was financed entirely by CFI's. So you had the South African DFIs as well as internationals, but no commercial banks were involved in that deal. There is currently another CSP tower project currently being looked at in SA which is the Redstone project which is also by ACWA Power actually, but that has a few covenants which is linking the close of that transaction to the **(wording unclear)** projects in the US such as Crystal Dunes and other project in Nevada in the US. So the CP's to that transaction is that **(wording unclear)** has to close and has to operate at a certain performance and at a certain period of time, so unfortunately they have linked the performance of this tower project in SA to the US one, primarily because of this big operational track record.

Jane: Ok great. I see that Eskom is currently developing a tower CSP project which is currently does not involve any of the commercial banks.

Bhavtik: Yes. So you see Eskom has not had a big power plant built in SA for the last 20 to 25 years, now they have two which are Medupi and Kusile – each around 4 500 MW, and because they were coal, they actually managed to get finance from the World Bank. One of the conditions of that financing of the coal project from the World Bank, was that have to adopt some sort of green link, thus Eskom has now got two renewable project where one is the CSP Tower project and the other is a SERE wind farm. The conditions of this was primarily because they need to move away from coal.

Jane: Yes, that is really interesting, thank you.

So the next question is that The Bokpoort has been viewed as a landmark in REIPPP and has won a number of awards. Why is this? What has made this project deal so unique and/or significant?

Bhavtik: Well remember that this was actually done in 2011 and closed in 2012. Still at that stage, you know SA had launched its RE programme around late August 2011, and so basically this was very much in its infancy as a new asset class as renewable energy was at that stage in SA, and the terms on that were pretty aggressive bearing in mind that it was a

technology that had not previously been pursued previously in the banking fraternity in SA. So you had a project that was in round 2, it was 50 MW, very large CAPEX, you had a tenure of 18.5 years at that stage and on a 20 year PPA that was pretty substantial., it was also trough technology where as I said earlier that none of the other RE technologies whether wind, solar PV, or CSP had really been done previously in SA, and so it was kind of aggressive for SA at that time, albeit that it was a technology in use in California since 1985. Also you had an elite sponsor which was ACWA Power which was in this deal and it was the first foray into Africa or sub-Saharan space, so that was also what I think was unique, and they also closed this with a lot of odds against them where you had their O&M entity which was called Nomic, which was an O&M entity in the ACWA Power Group that typically had a lot of experience on gas, not a lot of experience on coal and certainly no experience on renewable energy or CSP specifically. So that was again unique for them. There were also quite a few structural nuances on that project in terms of standby facilities, in terms of threshold ratios of the debt service coverage ratios that were pretty aggressive, bearing in mind that this was a new technology for SA. It had Cash sweeps, it had long tenure, and you had the evaluation of the resource being done on a P50 basis, which for round 2 or in 2011 was very aggressive.

Jane: Sorry, Please could you just repeat that last little bit please?

Bhavtik: So basically when you evaluate a renewable energy project, you evaluate the resource based on a confidence interval of either a 90% or 50% confidence interval – what we call a P50 for 50% confidence, or a 90%, which is a P90. And this project was done on a P50. So basically, whatever their stated resource was, we accept it at a 50% confidence interval or with 50% accuracy. At round 2, a lot of banks were still employing P90 evaluation, and this project was done on a P50 basis. You know obviously the market has moved quite a bit now and we are looking at a number of projects being done on renewables anyway, so particular, being done on a p50 basis because we are more familiar with solar, but at that stage it was quite novel for SA and Barclays was quite actively aggressive at that stage using P50.

Jane: Ok great, that's really interesting. Now there has been a lot of news on the 'economic empowerment funding structure' of this project. What's the unique empowerment aspect of this project? Is because of its high local content?

Bhavtik: I can't recall the specifics of their empowerment structure, but I know they did go pretty aggressive on the...

Well basically the RfP in SA for renewables had a requirement of a minimum of 2.5% requirement for a community trusts and a 11% requirement for BEE Shareholders, and the norm seemed to have been 5% community trust and up to 25% BEE. And so I think this particular project went on a threshold for BEE higher than the minimum or what was required by the RfP. That was probably what was also different; also CSP has a fair amount of civil associated with it, certainly from a localisation perspective in terms of jobs creation and in terms of fostering skills and employment in the region etc.

Remember that this project was done in the northern cape, which is fairly sparsely populated, which is actually the most sparsely populated province in SA and it is an impoverished region. So this project will actually create a lot of short term jobs, and it went higher the minimum BEE threshold and the community trusts, so the community as a whole benefited immensely from either job creation or, what happened was that in the RfP you also have a requirement that within 50Km radius a certain community would benefit, where there has to be a broad-based trust that has to be established where that community has to benefit from the project being built. So again, with all of that together, it has achieved a lot at that particular stage of that project.

Jane: Ok great. So the debt to equity ratio for a Bokpoort plant – considering that it was a fairly new technology to the region – would it be more on the upper side of 70% to 30%, or what would the ratio be for a project like that?

Bhavtik: Well at that stage I was seeing a lot of projects – and there were exceptions obviously – but I was seeing a lot of projects being done at a leverage of about 70:30 at round 1 typically, and this was a round 2 project being done at around 75:25, and which I thought was... well the market had moved already from round 1 to round 2, so this was probably not done overly aggressive, but a lot of projects at that stage were still being done at 70% leverage of senior debt and this was already at 75%.

Jane: Ok. So for this particular project did you face any financial challenges in the run up to financial closure?

Bhavtik: No not really, you know with these things there is always something that you never foresee and there weren't any particular challenges pursue, the deal got done within good time and within the time frame stipulated by the Department of energy. So I don't think there were any particular challenges pursue, but there is always stuff that you need to get your credit committee cross the line with, and as I said it was a new technology, credit had a requirement, as I said, that we needed not be too aggressive and just stick with the market. You know this particular project had pro-rata equity draws, as opposed to say equity first or equity drawn up first, so it was pro-rata, you had stand-by facilities, you had a fully wrapped project with full with single contracts sort of lump-sum EPC turnkey long-term contracting as opposed to sort of multiple split based project contract basis. You also had the O&M contract structured with certain incentivisations to outperform the warranted level.

Jane: That's very interesting

Bhavtik: So the O&M shareholder did not hold an equity stake in the contract, but they were certainly incentivised in terms of the O&M contract to do better than what was actually warranted and if they did they were incentivised appropriately financially.

What else can I tell you...

You know you also had the DBSA here in SA that was the largest lender to this project. So there weren't any challenges from an equity perspective pursue, but these are just a few of the challenges I can recall on this project at the time.

Jane: And once a project is given a 'preferred bidder' status are you given a certain amount of time to reach financial closure?

Bhavtik: Yes, so the way the RfP was actually structured was where you had a submission date. Well you had a date by when you had to register and notify the DoE of your intentions to bid in particular round. So once you have registered then you have a certain timeframe by when you actually need to physically submit your bid, for example in the current round - round 4 - all the 1800 MW upcoming the submission date is 1st October, so you would typically have to submit your proposal by a certain date which would be about 2 months before that or at least 6 weeks before then – the date is known but I can't recall it at the moment. So once you submit your bid the expectations are that the IPP office will announce the bid winners within 2 months of that submission date. And from that date of announcing the preferred bidders it takes 6 months to get to financial close.

So that is typically the way it is structured, but again what we found is that a lot of the projects in round 1 in particular, bearing in mind that it was a pretty new in SA at that stage. It was a new asset class for banks in SA, for EPC contractors, for law firms, for the developmental financial institutions, you know a lot of projects didn't necessarily achieve closure within the 6 months – they went slightly over that – but they all closed pretty comfortably without any major hiccups. But the timeframe stipulated in the RfP was 6 months from the date of announcing the official preferred bidders was the time to get to financial close. And there were certain delays that were outside the control of the sponsors, for example, Eskom's single buyers office, was signatory to the PPA's and obviously Eskom has had a few financial challenges, so there had to be certain approvals that had to come from government for Eskom's obligations etc. and those dragged on a bit and hence projects didn't necessarily achieve financial closure in the 6 months stipulated but dragged on slightly over that.

Jane: Talking about Eskom, has there been concern from debt financiers and developers about Eskom being the single off-taker – for the reasons just mentioned such as their financial challenges?

Bhavtik: Well from the banking fraternity here in SA, there has been a lot of comfort from the financial community, simply because we understand that this is mining territory and Eskom is 100 percent owned by the national government. So even with financial challenges, it still has got a lot of muscle and still the largest utility, in terms of megawatts, in Sub-Saharan Africa or actually in Africa for that matter. It still is generally an effective organisation, and I think the way that the programme was actually structured was that you have Eskom's single buyer office being the off-taker under the PPA, you had an implementation agreement that actually resulted in the department of energy standing behind the obligation of Eskom in a default scenario. So ultimately you have the South African Government standing behind its 100 percent owned subsidiary

and um, so we had the SA government standing behind Eskom and the PPA obligation in an event of a default scenario. So worst case, we knew that we were covered.

Jane: Ok good, thank you. So the domestic financial institutions in SA have been the main debt financiers – where you have provided nearly 80% of the debt for these renewable energy projects. So why do think that there has been less appetite or attraction from international financial institutions?

Bhavtik: Well Barclays was actually one of the first financial institutions to try arrange finance from an international entity for a SA renewable project. In round 1, we actually managed to bring OPEC into a deal which is a US institution that is there to support a type of US nexus. In other words if there was a US developer or stakeholder, then OPEC would actually support the project where there was a US nexus. So there was a US developer on solar farm and Barclays actually looked into bringing OPEC into the deal by virtue of the US nexus. And also on other projects such as that with a European wind developer, we have actually been able to tap the ECA market to get that respective ECA to support the scope that imitated from Europe for the wind turbine – we were the first bank to do that. But by in large, this is a Rand PPA, a Rad tariff, and a lot of the funding with a few exceptions has been done by SA financial institutions. Typically because, you must remember that SA banks are also very large by international standards, maybe not the size of some big banks in the US, but certainly they are not Mickey Mouse entity's either – So they have a deposit taking licence which means they are able to fund in Rands more competitively than international banks can. So while there are many international banks here in SA, not many of them have a retail bond spread, thus aren't in a position to fund in Rands easily or cheaply. Where SA banks have that edge over their international peers, but if you are looking at raising dollars then the flip side will be true where the international banks can raise dollar more cheaply by virtue of their better weighting in the US, Europe or wherever compared to what we can. So typically they will be cheaper on dollars and we will be cheaper on Rands - that is the main reason. So while there has been some internationals that have looked at it, generally it as just been cheaper for a project sponsor to raise funding for their project from a commercial bank than to try borrow from an international bank.

Jane: That's really interesting. What is your view on commercial and international banks appetite in providing finance for CSP project projects specifically? Is there a lot of interest or do they view these projects as being too risky?

Bhavtik: Well that's the interesting question actually. While, as a mentioned this earlier, there has been a lot of interest and support for CSP trough where many commercial banks have funded it, since there has been a lot of work on this technology and it has a demonstrational track record, this is not the case for CSP Tower. If you look at CSP tower by in large, you will find that this [CSP Tower] is almost entirely funded by PFI and the like – there hasn't been a lot of commercial bank interest in funding CSP Tower. Certainly if you look some of the internationals nearby like FMO, which is the Dutch entity, DEG/KFW which is the German entity, or ISC. They have looked at funding the tower technology and there has been one by at the key project which was funded by a

British nearby. But there was no commercial banks on that deal in SA. But certainly that is the extent of the involvement of the internationals. So this kind of speaks to your last question as well. Also, I think there is certainly an appetite from the internationals, as well, and you will find that the mandate of the [...] is somewhat different than the commercial bank. They are there to support, obviously, the developmental funding angle; they have a different objective from the socio-economic perspective. They have been there to support sponsors where you find commercial banks have been shying away from. So, typically you will find that on the key project, which is the CSP Tower, there are a lot more internationals there than there were any commercial banks. So the appetite is certainly there and they will obviously look at trough technology as well. But they may, you know, constrain their appetite to what the commercial banks may not be talking about doing, which is like looking into coming into the tower knowing that there is certain appetites from the commercial SA banks for trough.

Jane: Ok, that's interesting.

Bhavtik: The appetite generally is there. And remains to be quite good. I just think there is some sort of concern—some constraint for CSP Tower from commercial banks. But certainly I think the **(wording unclear)** or the international **(wording unclear)**, in particular, are more open to it.

Jane: Ok, great. Thank you. That was really interesting. Thanks. Question number seven has got to do with the implementation of Basell III of the Basel court. Are you familiar with that at all?

Bhavtik: Yes, I am broadly familiar with it.

Jane: Ok, yeah. So, Basell III records that it is meant to be implemented by 2019, I think. Sorry, it I got 2016 in the questions. Would that have any effect on the lending ability or the liquidity of the commercial banks?

Bhavtik: I thought without doubt, yes. So for the date of the actual implementation, to my knowledge, is the 1st January 2017. Which is only slightly more than a year away. SA banks generally, certainly I can talk for Barclays, has already starting implementing those requirements under Basel III and, so it has been quite...it's actually been a double-edged sword so to speak. So in one respect we have, you know, been very proactive and implementing the new the requirements that will be effecting banks. But the flip side of that is has been punitive in some respects, in terms of all-capital and requirements. What that actually means is that—in short it means that if you are funding long term or are looking at long term project financing it does become more expensive. And typically these projects on project financing is it not characteristic to look at 18-20 year funding. Or even longer. So it does becoming punitively more expensive because banks have to hold more capital against long term lending. If you are funding over short term, one year or just two or three-four years it is cheaper because the capital adequacy requirements are a lot less. So, certainly I do believe it will have an impact on long term financing lending. In the sense that it will becoming more expensive. But certainly what the bank is doing, what we have been doing as Barclays is looking at more solutions to

try and see what can be done to deal with the project or to try and come up with creative structural alternatives. So that, you know, the benefit is enjoyed by the sponsors for the short term.

Jane: Ok, Great.

Bhavtik: So we are looking at various things, but I can't get into a lot of it. But basically we are looking at creative alternatives to see what we can do from a structural perspective to make sure that the implementation of Basel does not severely negatively impact our sponsors on their projects.

Jane: Ok, that's interesting. Thank you.

Bhavtik: And what you will find is that DFIs don't have that constraint. DFIs are not restricted by the limitations of Basel. So they typically don't have the same sort of capital adequacy requirements as we do. If you look at the DMIs like the IDC, or the DBSA, or the FMO, or the DEGS, or the CECs of this world or KFWs. They don't have the same Basel implementations and they are not impacted to the same extent for long term funding. So, one of the sort of concerns is will DFIs cut off commercial banks? If you speak to the DFIs they will tell you pretty much: 'Look, we need the commercial banks.' Because typically DFIs will typically lead the process they want to work with the commercial banks to get a transaction over the line. But at the same time, especially when looking at African projects etc., which many of the European DFIs are not necessarily always familiar with, they would need a local bank or a bank more active in the region to lead the process [...] And they will take a portion of the debt but they will be more passive in leading the process. So, I think there is definitely an opportunity for us to kind of co-exist. And you will find that in as much as the DFIs are not impacted severely by long term lending or by Basel implications I think there should be critical cooperation between commercial banks and DFIs, in particular, to get projects over the line in countries like SA.

Jane: Yeah, great. That was really interesting. Thank you. Next: so, over the past three rounds, specifically in round three, there has been a shift away from project finance to corporate finance. I think in round three, 6 out of 17 projects changed their finance structure to corporate finance. Why has this shift occurred? And, you know, this obviously involves the banks in projects.

Bhavtik: Yeah, I think the shock to the system actually came in around round two. So you know, basically in round one you had, what is it, 47 projects or whatever—or 27 projects rather. Where you had a number of projects... all of the round one projects had pretty much received a terra close to the cap. So at that stage SA had a cap implemented of when the **(wording unclear)** all of the projects at that had exceeded at that stage had a terra almost at the cap. So I think developers went in with that sort of mind set for round two. And, obviously, if you looked at the RFP they were very clear that the waiting evaluation of projects was 70% in favour of price. 30% was in favour of what they called ED criteria, or economic development criteria, looking at various sub criteria that entailed things like localization, local content, media share holding, **(wording**

unclear) management, all of those things. So, what happen was, again it was, you know, a lot of developers went in with pretty high expectations of getting a **(wording unclear)** close to they exceeded in round one. And they came short. It was a shock to the system because you had very few projects, if you look at the number of successful preferred **(wording unclear)** in round one you had 27—I can't remember the number off hand, but in round two it was a lot less than that. And a lot of developers would kind of shocks because the tariffs were significantly lower in round two than in round one. In fact, I can give you an example: if you looked at wind in round one the average tariff at that stage was 1.14 rand per kilowatt hour; in round two, it was 89 rand cents per kilowatt hour. If you looked at solar **(wording unclear)** it was 2.64 per kilowatt hour and in round two it was 1.65 rand. A lot of developers that did not succeed if you go back looking in what they did not succeed you would find that their tariffs were significantly higher than what the average tariff was in round two. So [...] was closer to what the expectation was in round one [...] so what you had was this learning curve effect on solar modules. It was sort of an abundance of solar modules on the market coming from China, who was supplying the world's stage. You had the wind turbines that had this learning effect, that's what they call it. The cost of technology [...] on solar was more so than [...] in the three to four years. So a lot of the [...] thought we can definitely get up a really high IRR, why should we lower our tariff? And they came short because, clearly, there was a strong emphasis by POE to push tariffs down and those that came in cheaply at the ones that succeeded. So, it wasn't necessarily a case of that, you know, the project finance was all broke. It was just the case of developers where trying to buy [...] into success. A lot of the developers by round three were large scale international facilities or large developers for a very big branch, they felt that one way of trying to succeed let us leverage our superior credit rating, our strong balance sheet, obviously, cheaper funding on a corporate finance basis as opposed to project financing, which is typically more expensive than a typical corporate finance. And that's probably why they felt that well this might be our way of getting back successfully. And if look at the likes of the NL, that's what they typically did. They came in with corporate finance. So NL, you know, and HD have got 120,000 megawatts, it is a 60 billion euro entity market cap. They can raise funding at very, very competitive rates compared to a small size developer in SA. So, they basically leverage the market to their advantage that's what happened. But if you look at—so that's what happen in round three on the back up of round two people tried to come up with [...] solutions. The market had moved considerably from round one to round two to round three and came up with the idea of trying using corporate finance. But if you looked at round four, 4A and 4B you would have found that a number of developers employed that successfully, employed project financing again. So it's certainly not out of vogue again. To be looking at the next round in [...] in megawatts again it's again back to project financing. I don't think project financing is out of vogue. It's just the different strategy that kind of helped developers grow back their rate of success as demonstrated by round two.

Jane: Ok, Ok. That's interesting. Next question, oh this is the question that I added in that email. It is to broaden the debt financing base, are there any alternative debt financing mechanisms which could be considered for projects? I know there has been talk about

the use of bonds. I think Soytec, the solar company and developer, used bonds in round two or round three.

Bhavtik: Yeah, so as I've said the market has matured in the last three and half-four years considerably. SA banks certainly have really strong—you have a really strong financial system, a lot of sophistication in the financial markets here in SA. And, you know, all the sort of structures that can be employed or have been employed in many of the other parts of the world have already been looked at in SA certainly since we have evolved from round one to round two into three and then into four. So the structures have gotten pretty aggressive. So, you know, some of the other...while the structures have gotten aggressive for example, I mentioned leverage moves from 70% as an average in round one to you know 82.5% say or 85% in round four. The tenants have actually gotten longer, funding tenants, postal instruction with a bottom of 15 years in round one, as an average, has gone up to 17 years or so in round four. Various nuisances have crept into the system. But in addition to all of those aggressive structures I also mentioned P50/P90. Where P90 was most likely used on solar more in round one and you would have found that the market has moved into round four more aggressively. There are definitely structures being looked at from project bond perspective in SA. The Soytech you alluded to was not your typical project finance bond. It was a structure that was employed and I think this was around one project. It was a CVT technology, so concentrated (**wording unclear**), now as a technology CVT was very hard to bank because there haven't been a lot of CVT projects globally. And the sponsors at that stage, Soytech, in order to get it off the ground and to take it to close quickly actually did that with some sort of corporate support directly from Soytech. So project one was employed, well they called it project round one, but it was not your typical project bond that would find in the US or Europe or the Mid-East. Because it had structural nuisances and it had certain credit enhancements to escrow accounts and to—in a certain innovation in that. That would typically not be employed in your typical project bond structure overseas. So you had escrow accounts, you had, you know, a certain [...] in the construction period. You had investment into tradery stock, for example, and also some stuff—that was largely done because of the concerns around the technology and construction risk with the technology. You know there is—because there was bond there actually is a memorandum, an issuing memorandum that was issued and if you can lay your hand on it you would find a lot more detail on that.

Jane: Ok, Thank you, yeah.

Bhavtik: I might have access to it. If you can send me an email to try and look for it. I'll try and find it for you.

Jane: Thank you that would be great.

Bhavtik: But that was a really unique structure you would typically be employed on your typical project bond. But all in above, project ones that we are looking at more aggressively now, without the Soytech structure. We are looking at, obviously, synchronizations, we are looking at sort of refinancing your early projects. So we are post-construction when

the project is dealt with [...] once the construction is up and running, post-construction with a [...] rate corp, then you'll find a lot responses internationally tend to refinances. So that's been looked at. But the SA RFP has a requirement that: refinance may only take place with the consent of the DUE.

Jane: Yes, I knew that, yeah.

Bhavtik: You know, there is negotiation to be had that if you refi what happens to the gain? If you refinance at a certain interest rate—sorry, if you funded initially at a certain interest rate, when you refi that the expectation is that you would probably have cheaper pricing maybe a longer [*noise interference*] there is a gain to be had. Then the DUE would have the right to on how that gain is to be shared. If you look at the SA PPPs, the gain is to be shared on a pro-rata basis, specifically between the sponsor or the developer and the national treasury or whichever department actually procuring that PPP. So, those sort of things, again, would require consent and discussion or final addition from the DUE before they would allow you to refin. [...] So you are looking at inoperative structures, bearing in mind the implications of Basel III. We are looking at other structures sponsored to get the benefit of possibly shorter funding and if they are able to take the refinance with, we are happy to give that shorter term funding.

Jane: Ok, good. Ok, thank you.

Bhavtik: Sorry, one—the securitization, there is, um, refinance initiatives on earlier projects they are shorter tenants being looked at. Those are some of the innovation that actually coming through. There are also other things, like mini-bums, which is sort of the short term financing that we are talking about. And you get what they call a hard mini-bum and a soft mini-bum. So are hard mini-bum is when you have a drop-dead date where the debt must be re-paid. And a soft mini-bum where you have ratchets on your margin, on your interest rate. So, for example, to induce refinance you will find that your margins between certain years creep up so that is called a soft mini-bum where it is not mandatory. But because of the treatment of interest rate margins it kind of encourages the sponsor to look at refinance market. Whereas, a hard mini-bum is it has to be paid by a certain date, you know, it has to be re-paid by year six or year eight or whatever it is and it forces the refinance.

Jane: Ok

Bhavtik: Then you have other things, like yieldco structures. You know, yieldco are the vehicle that existed and—

Jane: So what is that? A yield-co?

Bhavtik: B: Yeah, yield: y-i-e-l-d. Yieldco.

Jane: OK

Bhavtik: So yieldcos are something you can look at. It has been done in the US and Europe and talked along those lines in SA. So what happens is, it is a listed vehicle to IPO an

aggregational asset held by the yeildco special purpose company and it is basically a growth vehicle. So basically, they hope to actually lift operating assets and try, um, and capitalize on the growth story of an additional pipeline that will be developed by sponsors. And in so doing, lift the entity and try an exit in the shareholding that the sponsors initial had in the project.

Jane: Ok, interesting.

Bhavtik: But its something, you know, that has been done in the US and Europe, but it is very new and hasn't been done in SA. Entities are looking at that, banks are looking that, sponsors are looking at it. But it remains to be seen. You know, there is obviously, the issue about first mover advantage but there are a lot of things that have to be thought through first. And nobody really wants to be the first one to go ahead and—because you don't know what sort of discount rate it would buy the asset etc., so yeah.

Jane: Ok. Ok. Great. That was really helpful, thank you. And then lastly, shame I know this has been a bit longer than what you had planned. What recommendations do you have for the improvement of REIPPPP and, also, I suppose this is two sets of questions. So the improvement of REIPPPP and, also, for the further deployment of CSP plants in SA?

Bhavtik: Well, I think, um, you know, just in terms of the REIPPPP posted in SA I think it has been pretty well overrun. There is really no sort of recommendations that necessary come to mind regarding the process. You know, the SA government, one of the reasons the project program has been so successful was that the government actually spent a lot of money hiring the best consultants from a technical perspective, from a legal perspective, from a financial perspective to help them put together an RFP that was robust and that was kind of acceptable broadly to the financing community and to the development community. And testimony to that is really had in the number of developers that were all internationals. So, literally every project had an international developer with an element of local shareholding. But there has been phenomenal interest across the spectrum from developers, mostly in Europe and some in Asia and elsewhere. But, and you know, if you look at the four rounds that have been had, you have something like an average of about 70 projects per round. So across the four projects you had something like 280 projects that have been built. And almost all of them have had an element of internationals. So the interest has been phenomenal and that speaks volumes in terms of how the process has been structured and the quality of the RFP that is has been gained through. So the deal he actually had, for you the actually have access to the requirements of RFP or to have access to the RFP that you have, you actually have to pay a fee.

Jane: Yeah, it's 15,000 isn't it?

Bhavtik: And there is one-way kind-of self-funded the use of these expensive consultants. You also had to pay, I think it was 2.5% of the project cost to the DUE. I can't remember, I think it was 2.5%. For, um, you know, just for this program. All of that actually helped it was funding that went to DUE. And it helped them to the development of the renewable program, the Basil core program, which has just come out, subsequently, and the gas

program, which will come out. So it kind of helped them self-fund before the initiative. And helped them make the best use of the consultants from the financial perspective, technical perspective, legal perspective. And these consultants are not cheap by any means, right?

Jane: Yeah.

Bhavtik: So that was done well. I think, um, one of the things you would want to find is, um, you know, we have spoken about this, you have funding largely by the SA institutions by and large. And not a lot of international commercial bank interest. Maybe that is something that can be looked at. I suppose the one issue for the internationals is whole [...]. They have a requirement for returns, dollars and euros, etc. The rand is such a volatile currency, because it is so liquid. It may not be necessarily appetizing for them. One of the ways to try—one of the things the DUE should look at is trying to see what can be done to encourage international bank participation to a greater extent. Because you got the initial IRP 2010, the integrated resources plan, talks about 18.4 or was it 17.8 gigawatts, almost 18 gigawatts to be procured from renewable energy. So that was 8.4 gigawatts on wind, 8.4 gigawatts on PD and 1 gigawatt from CSP. That is a lot of API, or that is a lot of cappax that needs to be funded. There is obviously has been great appetite from the SA commercial banks, the asset managers, the pension fund, etc. But when you factor in that you've got renewable energy, you've got coal programs that will be coming on stream, you've got the hydro projects that will be coming on stream, you've got a number of other projects that need to be funded across other asset [...] like PPPs, your hospitals, your toll roads, your office accommodation for government buildings, it is a lot of funding. There's obviously—so far it has not been a constraint and I think everything has been great and well. But I think when you start factoring in a lot of these it does become a lot of funding and it would be good to see, you know, what other pools can be tapped into to help these continue momentum and ensure that there is no constraint from a liquidity perspective.

Jane: Yeah, that's true. And particularly any comments...Well I suppose we have spoken quite a lot about CSP, but any other additional comments you would like to add about the deployment about CSP in SA and its future?

Bhavtik: Well I think just regarding CSP towers specifically—and as I have said there hasn't been a lot of big projects—now remember the cap has moved up to 150 megawatts. There is no project in the world at the moment that has been operating at that scale for a long time with CSP tower. So one of the things to try can get banks more comfortable and being able to sell this to the credit committees or investment committees in the case of equity providers is that you would find that you would probably need a better or more robustly structure security package from sponsors. If that is done then I think [noise] typically if things like liquidated damages on performance, on delays, rejection rights in the case of EPC. So all of these things, if you can provide a more robust security package to commercial banks then you will find that banks would be more acceptable to CSP tower and would be more available to fund these. And as it stands right now I think the interest is certainly there from commercial banks more so for trough as opposed to

tower. Because of the lack of huge operating track record at the scale we are talking at in SA. So if you could do that I think you would have more commercial banks getting on with the tower. Obviously, this is naturally die down as you have more prompts set up and pre-constructed, up and running, connected to the grid, generating power for a sizeable track record. But I'm sure that happens I think you would expect to see more from the EPCs and from the sponsors their projects to get over the line to get banks comfortable.

Jane: Ok, great. Ok, great. Well that's it for today. Thank you so much, Mr. Vallabhjee. You have been a mind of information.

Bhavtik: Not at all Jane. But before I leave you, just one other thing: I think, we spoke about SA program and what's been done well, what hasn't been done well. I mentioned the world structured program. I mentioned how the DUE went about it working with the top, best of the **(wording unclear)**, consultants. I mentioned that you had government that had implementation agreement, which is essentially a guarantee for the uptake of the agent of the escrow, which actually helped the funding community and sponsors with interest in the program. So these things have opened very well for SA. You also had another thing where RFP has been released pretty much on a take it or leave it basis. So you have it, as a sponsor or as a bank you are not allowed to mark up the documentation. So there was a lot of consultation that went through initially and before that RFP were released, but once that were released you could not mark up stuff. You pretty much had to accept it, accept the documentation in the RFP. And this has actually helped get projects up and running pretty quickly. So if you looked at SA over a period of three and a half/four years you have had 92 projects, 92 IDPs and something like 6,000 megawatts. And not all of it is commission but 92 projects have been allocated, is good. But it is always in excess of 2000 projects have already been connected to the grid and renewable energy. And it's not happened in that size or scale in anywhere else in Africa. And its all be it SA has been linked to the party up to renewable energy. It's still a fabulous feat in a very short period of time. So it speaks volumes in terms of the way the government or the way the DUE have orchestrated this whole program. And one of the other things, there was a survey that was done by one of the international law firms, called Baker-McKenzie, about 18 months-two years ago. And according to that survey they found that 80% of the renewable energy typically in Sub-Saharan Africa over the next five years would be in SA. And clearly you can see this. There has been a lot of momentum. And your government has obviously come up with the 1800 megawatt round, which will be the next allocation and the submission date for that is the 1st October. In addition to that you have another 6800 megawatt that will go through as, you know, the new megawatt perceived as the future for renewable energy. It has been a phenomenal—there has been a lot of traction and a lot has been happening in a very short period of time. Yup, so that's it from me in summary.

Jane: And what about uncertainty about regulations in the future? Cause I mean we have REIPPPP, which the government has supported and backed, but it is coming to an end, we've got the fifth round, the final round now in October. What about, you know, what's the sentiment? The investment sentiment around certainty of regulation?

Bhavtik: Well there is always a risk and I think you could look at development markets like Spain and Germany and Italy and stuff. They had a Refrit program and the government renat on the tariff they committed under the Refrit. We don't have a Refrit here in SA. We sort of out and taken care of itself through the cap scenario and reverse auction process with this just sort competed against each other. But it sort of does regulate with certainty. I think SA is very mindful that we not this way. So we are not a—we are still very much an emerging market. The reputational risks for them to actually [...] on something is huge. One can never say never but I think they are very mindful if they do that it would be the end of FDI in SA. So they are trending very, very carefully in that regard. So they have been very cleaver in the way they have come about in this program. You look at the last round where they have had a cap tariffs re-implemented it was a removed for round two and three and four. But it was re-implemented for round five, the 1800 megawatt round. And that kind of affects the upper-limits of how aggressive you can be for your tariffs. And through the competition it is the survival of the fittest. So naturally it kind of ensures that the lowest common denominator succeeds those projects with the lower tariffs succeed and hold through. So the end consumer in SA is kind of benefitted. So there is less risk, I think, of governments having to force their hands and try to re-negotiate tariffs downwards because it is kind of taken care of itself by holding the tariffs over the four rounds so far.

Jane: Ok, good. Ok, great.

Bhavtik: Alright Jane.

Jane: Ok, great. Thank you. Thank you so much again.

Bhavtik: It's a pleasure. I hope all goes well for you. And, yeah, don't hesitate if there is anything else. I'd love to see your final dissertation when you have gotten it all ready and approved. Do email me a copy. I really would like to see and comment on your work.

Jane: Yes, of course. I'll do so. Okay, Thank you.

Bhavtik: Thanks very much. If you are coming to SA on holiday again pop around it would be good put a face to a name. Who knows we might need a candidate here at Barclays and we would look kindly to you.

Jane: Mr. Vallabhjee, be careful I might take you up on that offer.

Bhavtik: [Laughs]

Jane: I am finishing at the end of August. So if you need any help around the office due give me a call.

Bhavtik: No problem at all Jane.

Jane: Great, thank you. Let's chat soon. Bye-bye.

Bhavtik: Bye.

INTERVIEW QUESTIONS

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Nicolas Tucker

Questions

1. Could you please provide me with a bit of background on yourself, specifically explaining your/ Investec's involvement in the Bokpoort 50MW Concentrated Solar Power (CSP) Project?
Has Investec been involved in the financing of any other CSP projects?
2. The Bokpoort CSP project has been viewed as a 'landmark in REIPPP' and won the *African Renewable Deal of the Year* at the 2013 Thomson Reuters Project Finance International (PFI) Awards. What made this project deal so unique and/or significant?
3. What was the debt to equity ratio for the Bokpoort 50 MW plant? Do you believe that this is a sound ratio for a project of this magnitude?
4. What financial challenges did this project face in the run-up to financial closure, if any? And with that, what solutions were put in place to overcome these challenges?
5. What are the risks associated with CSP technologies?
6. Domestic financial institutions have been the main debt financiers for projects in SA's Renewable Energy Independent Producer Procurement Programme (REIPPPP), so why has there been less 'appetite' from international financial institutions?
7. What do you think is the attraction/appetite for both domestic and international financial institutions in providing debt finance for CSP projects in SA? Does this 'appetite' vary among different CSP technologies (e.g. trough, tower, dish etc.)

8. Is Tower a superior CSP technology?
9. In the future, do you think we will see more tower technology than PT? PT has dominated thus far?
10. Does CSP have high localisation potential in SA – Opportunities for a CSP manufacturing sector to develop?
11. The nature of financing projects has seen a shift away from *project finance* to *corporate finance* between rounds 1 and 3 of REIPPPP. Why do you believe this shift has occurred?

Do you believe that this trend is likely to persist in the future?
12. To broaden the debt financing base, are there any alternative debt financing mechanisms a renewable energy project could consider?
13. Do you have any recommendations for the improvement of REIPPPP and for the future deployment of CSP plants in SA?

INTERVIEW TRANSCRIPT

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Nicolas Tucker

***NOTE:** This interview recording was very grainy and unclear, hence making the interview difficult to accurately transcribe

Nicolas: So there are certain things that I cannot divulge due to confidentiality reasons. What I suggest you do is I can try and put you in contact with somebody at **(wording unclear)** who is the sponsor for the deal and then they will be able to obviously disclose things more freely. So that's my suggested approach. But lets see how we go with everything and see how far we get.

I am a CA by profession. I have been in banking for about 7-8 years in project finance for pretty much the last 4. I initially worked at Nedbank in the project finance team, I then moved to the Industrial Development Corporation (IDC); I then worked for a year by myself working only on renewable energy projects. And I have been at Investec for just over 2 years now.

In terms of my exposure, I have worked in 2 CSP deals in round 1 with the IDC. I was briefly involved in the **(wording unclear)** transaction of environmental affairs that Investec participated in. And I **(wording unclear)** see whether Bookport deal was being done but I am quite familiar with the transactions. I wasn't here when the deal was closed.

I am aware of some of the challenges they have which are: some are fairly unique to this project; some are fairly unique to CSP as a whole. So I can give you a little outline on those. At the moment Investec has been awarded, we co-developed a CSP project with **(wording unclear)** who's now called the NG **(wording unclear)** in the round 3 that was last year in March, where one of the projects that we co-developed with **(wording unclear)** was awarded a 100MW project. Working towards financial close on that at the moment. It's a little bit about me and what I have done.

There is an organisation called CSP Today, which is based in the UK, and I have spoken at a few of their conferences. So I know a fair amount, I'm not a technical expert but I can work my way around it.

So that's my story.

Jane: Could you comment on why deal so unique or significant?

Nicolas: In terms of the whole BEE angle and the economic development obligation, I don't think that this project is that unique in that sense. I also not familiar with how the whole **(wording unclear)** project works, but effectively in order to submit a bid, you have to have certain economic developments obligations **(wording unclear)** department of trade and industry together with the DoE, so you have to have minimum BEE shareholding, you have to have a minimum percentage of black parties involved with the EPC, **(wording unclear)** There's a whole formalised structure **(wording unclear)** some obviously are better at economic development obligations as part of the structure **(wording unclear)**

A condition to that, they have to spend about 1% or 2% of their annual revenue they have to spend it on social development. So what Bookport potentially does is have done is **(wording unclear)** so I'm not that close to that level of detail but just in terms of the economy **(wording unclear)** I would **(wording unclear)** revolutionary. It's compliant and there is a good angle to it, but I don't think that won them that award. The one unique thing with this project was that it was the first parabolic trough/CSP project in SA that used molten **(wording unclear)** storage. I'm sure you will read everywhere that it is 9 hours of storage, which at the time was **(wording unclear)** in SA. So that was the one really unique thing. So in sum the project should be able to generate **(wording unclear)** or maybe short of that. But long story short, it makes it easy because this can be used as a form of base load where you will be able to **(wording unclear)** once the sun has gone down and as you are aware SA has peak times of sun between 5 and 7 or 5 and 8 in the evening so.

Jane: So more the technology then the actual deal?

Nicolas: Ya. I think **(wording unclear)** that stands out on this project. I will double check if there is anything else. **(Wording unclear)** storage and the fact that it is closed.

Jane: What would the debt to equity ratio be?

Nicolas: I don't think I'm at liberty to disclose it. What I can tell you is that lower than a PV or **(wording unclear)**. Solar and wind are probably sitting around the 80% debt level and I can tell you that CSP is at that level at the moment.

Jane: Know of any financial challenges?

Nicolas: Ya so this one and also those ones I won't tell you over the phone. Any financing structure of CSP you talking in the region of R5bn or R12bn depending on whether you going for 50MW or 100MW. Its obviously been lots of parties around the table and the more parties on the table the more complicated it becomes **(wording unclear)**. This project did have a challenge that one of the lenders did walk away very close from financial close. That was on of the challenges that they had. That being said Investec was always on the table and increased there underwrite together with one of the other lenders that was on the table and that **(wording unclear)**. It was obviously **(wording unclear)** one of the things that was part of the deal. So one of the financial challenges was one

of the parties walking away, leaving a gap, but that being said it was closed and the projects on schedule to reach commissioning towards the end of the year. So it did close.

In terms of incorporating that I think that's something that doesn't need to be publicly disclosed.

Jane: What in general risks are associated with CSP technology?

Nicolas: I think the biggest thing that you find in CSP is that it is not as established a technology as solar PV or Wind. If you compare the number of gigawatts installed in wind and solar compared to CSP that is dwarfed by the others. So that's the one thing. Also the number of years that CSP has been around compared to the likes of wind and PV. Sometimes that is, when you do project finance structures, project finance 101 you do **(wording unclear)**. So, that is the mindset that everyone approaches these deals with. Then you will see that the parabolic trough is less to get back because, so Bookport was commercial basis **(wording unclear)** commercial banks **(wording unclear)** 100 MW parabolic trough and also that by commercial banks on a project finance basis. Where power is more challenging purely from a technology risk perspective. So every 50 MW project **(wording unclear)** in round 1 and there were no commercial banks on the tables. It was all the DFI, the IDC, IPC, DBSA **(wording unclear)** and the **(wording unclear)** were also there.

So solar is a lot more challenging to back because it has a lot less history than power. For example solar reserve, they are closely building a 100 or 120MW power in the states. That project is already a year late in terms of its commissioning and that would be the only power project **(wording unclear)**

Jane: Is crescent dunes in SA or the US?

Nicolas: It's in the states.

So that being said, solar reserve also been a **(wording unclear)** project in the CSP run-up **(wording unclear)** last year **(wording unclear)** and they also working towards financial close. And that there are only commercial banks around the table. That said, they haven't done financial close yet. So still wait to be seen the terms of that deal. If you have a look at all the tower projects done around the world. The cresein dunes project, the **(wording unclear)** project **(wording unclear)** but that's 3 times 100MW towers all of the same size. But that doesn't even involve self-storage.

So I'm trying to prove a point that tower/power is stale, isn't like strong operating **(wording unclear)** especially in **(wording unclear)** towers **(wording unclear)** GEMA solar and that's a 20 MW project. But here we trying to compare a 100MW tower to a 20 MW tower its not the same, there is some scaling up risk, so I think the biggest challenge that CSP faces is that if you try and bank on a project finance basis, their limited operating **(wording unclear)** stands against them, so how that manifests is either your meet the development financial chiefs to come in and do the financing, or the terms will be very conservative. So you will have lower gearing, you will have **(wording unclear)**

potentially EPC security package, so I think that that's the biggest challenges that they face is in terms of the terms of the financing it because challenging, not impossible, but a lot more **(wording unclear)** project finance basis because of a lack of operating **(wording unclear)** if I can put it like that.

Jane: In the future, do you think that there is going to be more CSP? Which technology will it be?

Nicolas: I think going forward tower will be the way to go, following the renewable programme in south Africa, but they **(wording unclear)** expediting bidding round in the first of October, and that has a 400MW CSP and I think that its been capped from 100MW per project and 150MW per project. But I can forward you some stuff.

But basically a the 40 to 50 MW available tends to be...projects that tend to be awarded and I can tell you now that all the banks have been getting involved and we expecting probably in the region of 6 projects bidding and at least half of those will be tower.

So I think there is definitely a shift towards tower projects going forward and it does make sense, I mean tower is a lot more efficient due to the higher temperatures, so the additional CAPEX is slightly more **(wording unclear)** it seems. From a CAPEX perspective it appears to be more than offset from the higher efficiency as a result of the higher temperatures. So at the end of the day, the cheaper tariffs going to win and it seems that tower is able to generate cheaper tariffs based on the technology and you know with the more tower projects that get built on a commercial basis, the more **(wording unclear)** so its like a ball that gets rolling, once it gets rolling everyone follows through.

So there has been I think a project in Israel that's a bright source tower projects that's been, it has secured commercial financing from (without) government guarantees and that obviously helps.

So it seems those four. I don't know how much has changed on tower because we still only dealing with one **(wording unclear)** plant which is that germal solar project, but it seems like they are more comfortable with the technology and it seems like that's what's going to happen.

Everything is driven by carrots, you know its not driven because of one looks pretty than the other. So parabolic trough could find something that makes them more efficient I think it would change the game slightly because I don't think it gets to some of the temperatures that some of them get to. But that being said there is talk of **(wording unclear)** sensitive coming into play for solar PV and battery storage. At the moment the batteries are still a little too expensive but to the extent that changes it could put pressure on CSP.

There is no exact answer to anything; I mean the world changes and its just technology and what people can get their minds around.

Jane: Do you think there is potential for CSP manufacturing industry in SA?

Nicolas: I don't know. The thing is you take CSP (**wording unclear**) and if its tower its lot of mirrors as well and a different mechanical structure. And then the turbine, which is a big component of the CSP part, is manufactured overseas and not here so evident. There already (**wording unclear**) local content in each EPC price. A lot of the metal used is procured in South Africa. The mirrors. I don't know if they are actually made here or still imported but they definitely start to get the mirrors made by the local glass people. So I wouldn't say that you could fully build a CSP plant from a South African component but there are definitely elements that can be expanded on in South Africa. One last thing was about CSP besides the storage part is the number of jobs it creates compared to a PV or wind deal. So CSP already has a lower (**wording unclear**) percentage (**wording unclear**)

Jane: Domestic financial institutions, been debt financiers, why do you think little or less appetite from international institutions?

Nicolas: Couple of elements to that question. The one is for foreign investors to invest rands into South Africa; the current lenders are putting 18 to 20 year debt per deal. So if you take construction, which is 2-3 years in addition to that, call it 16 years, so you sitting on a 20 yr. debt deal in rands. So for foreign investors to commit 20-year rands is challenging in itself. Because what they do is take dollars or euros, they convert them into rands and convert the cash from the rands back into dollars or euros. Now they need to take the foreign currency risk then they (**wording unclear**) but if the rand devalues the project can only see rand debt. So if the rand devalues and they covert it back, it makes less money so that is a risk that the foreign investors have if they have to commit 20 year debt unless they have sitting on pool of rands in south Africa that they want to invest. That's the one challenge

The other challenge is the way the south African programme is structured, you have a PPA which is a power agreement with Eskom and the DoE guarantees Eskom's obligation in the form of (**wording unclear**) So to the extent that Eskom defaults, the DoE guarantees obligation without WORD payment. Or the project gets cancelled, they will repay the debt (**wording unclear**) Now what they specifically say is that too the extent that there is foreign debt in the project, they will repay and guarantee the date, but the rate at which they will convert it is the lower of the exchange rate at which they signed the PPA or the exchange rate on the date of default. So by implication of if you have some \$100million loan and its R10/\$. You sitting with a billion Rand debt. Now 3 months later, the project defaults, and the rand have weakened to R20, now your billion rand is now worth half the amount. So they will still repay the billion rand but instead of it being \$100million they will have \$50million. So the DoE wont take the exchange rate risk so effectively the foreign lender has to take that. So that's also a challenge in securing foreign offshore investors putting in debt into these projects. So that's the one challenge, the other challenge is that the project isn't going to, that is not a guarantee. So in terms of the operational risk, the project is not going to take dollar debt into it and commit dollar payments and then run the exchange rate risk, and also they can't go and let out the dollar payments because if you go take a foreign exchange contract for 10 years on dollars, a (**wording unclear**) R20 on the dollar so that will more than

offset the cheaper financing coming from foreign lenders. So that's probably the biggest challenge around foreign investors lending into the program.

So it's the currency risk

Jane: The second challenge you mentioned with the PPA and Eskom being the single off taker, do you think investors and developers are concerned with Eskom defaulting?

Nicolas: (wording unclear) ya naturally concerned given where Eskom is. But if you take the fact that SA has power shortage. If Eskom doesn't (wording unclear) power we not going to (wording unclear) we not going to continue generating (wording unclear) variable cost of running the plant. So Eskom (wording unclear) power. So they will take whatever they can get. That's point one, so and if Eskom doesn't pay they do not get the power and if Eskom cant pay then we will rely on the DoE, which is national government and is national treasury. If national treasury can't pay then I think we will have bigger problems. So that's the one part.

The other part is percentage of total generation capacity is like 10-15%, its an absolute blimp on the radar, so (wording unclear) pushing the costs of power with the 15 % tariff increases that Eskom is asking for (wording unclear) a drop in the ocean. Even though its makes up 10-15% of the total generating capacity, renewable energy (wording unclear) 24/7. So somebody takes what the load factor of the 4000MW of renewables can be generous and say closer to 20-30%. You only sitting with like 1500MW of effective generating capacity in a 24hour basis on average but that is with a total pool of 50000MW. If you put everything into perspective, we are concerned about Eskom but it's highly unlikely that they wont pay for this power. Firstly they need it and secondly they need the RE power in the next, what was it the COP17 that was held here, World Bank funding was the basis of certain covenants and commitments, I cant remember which ones. So there are bigger factors at play that force Eskom's hand in paying for the power. And if they can't (wording unclear) if that makes sense.

Jane: Appetite or CSP and whether it varies between the technologies.

Nicolas: I think to recap on it. So far there are four (wording unclear). Two for the technology the issue that they have now is can they compete with tower to the extent that power can arrange financing, they will more than likely beat the trough hands down, in which case the tower will be awarded preferred bidder for the financing. But In terms of like linear frasanal, they struggle with the issue that tower (wording unclear) more so than a few years ago and less so now in the sense that they don't have a strong operating experience track record at any form of scale. (Wording unclear) have a project and you only have a 1 or 4MW plant, if that. That's basically where you are. I think to the extent (wording unclear). So real competitive edge over the others than they would start to have some reference sight or sponsors balance sheet or corporate finance or what the government guarantees just to demonstrate proven technology.

Jane: In Sa, so we have any dish sterlin or the fresnal technologies?

Nicolas: I don't know any fresnal. [Only knows about demonstration sight for dish]

But only CSP projects on a utility scale in round one were the **(wording unclear)**, the 50MW tower and 100MW parabolic trough. Round 2 was Bokpoort. Round 3 was the **(wording unclear)** and there was another **(wording unclear)** project. That was for 100MW **(wording unclear)** missing sentence. 100MW parabolic trough and solar reserves 100MW power.

Jane: To confirm, these towers have been publicly funded, not funded by commercial banks?

Nicolas: Only one tower, **(wording unclear)**, was not funded by commercial banks, the solar reserve 100MW tower is currently working towards financial close, but if they do it looks like it will be by commercial banks.

Jane: I've read that between round 1 and 3, there was a shift from project finance and corporate finance? Has that continued?

Nicolas: A point on that, the shift from project finance to corporate finance has largely been on solar projects, solar PV, and not sure whether any wind projects have been done on a corporate finance basis, but definitely solar PV. On CSP just purely due to the size I don't think it will likely be done purely on the basis of scale because it is far too big for any one balance sheet to support it. So, the 35MW PV project is probably sitting in the region of 1.3 to 1.5 Billion Rand so around \$100million, which certain large sponsors, can do on their own balance sheets. So for example, ENEL, the Italian utility ENEL, they were famous for contributing at first. They can with the balance sheet to support it, but the difference between \$100million and \$1 billion for a single project. I think that the trend will continue on solar PV and wind but not on CSP at all.

Jane: How could we broaden the debt-financing base in SA?

Nicolas: I think if anything, I think that international builders set a precedent **(wording unclear)** bonds **(wording unclear)** that probably the easiest one to broaden the liquidity base. Within the whole project finance there are alternatives, there is **(wording unclear)** money structures, but in terms of a funding base, I think project bonds is the next wave to **(wording unclear)** Other than that I can think of anything else. You can take all the bonds and securitize them but in the end you still looking at a bond type structure.

Jane: Do you have any recommendations for the improvement of REIPP or future CSP deployment?

Nicolas: I don't have anything major that can be improved, and I will tell you why. This REIPP programme has gotten international acclaim for being incredibly well structured, and well run and I think one of the other jurisdictions in RE are almost moving their programme off the south African one so its quite nice in terms of the structure.

I think one of the challenges that we face and that we must get around is the whole EDI obligations, and local shareholding and BEE shareholding. So to give you an example, the **(wording unclear)** programme, running in the background at the moment, the first bid is going in 20th of this month (August). There is a requirement to have a minimum of 51% South

African shareholding in the project. If RE the minimum is 40%. That creates an issue because the longer the projects go the more funding is required and BEE parties don't always have their own cash, they have a certain percentage of their own and get the balanced from the IDC, PIC funding and **(wording unclear)** come up with their own money. And also, as a letter to these projects, you want a serious, what we call, strategic shareholder at the table. They being forced to hold less and less equity for local guys who don't have the expertise and capability, which defeats the objective of the project finance transaction. Because the only recourse is the project and you want a party that is fully committed, fully invested, making it less **(wording unclear)** for things can go under. And **(wording unclear)** SA guys who effectively don't have the capital and are funded 90% by someone ask, you ask yourself the question, they are committed obviously but totally different to having the likes of **(wording unclear)** around the table to gigawatts installed capacity under management and if the project hits a bit of a wobbly patch, they will do whatever they can, be it throw in their own money or do whatever they need to do to make it work. But all of that being said SA is where it is and transformation needs to happen and there are certain policies they can make that aren't necessarily open for public, and it's a challenge that we face with the government that we operate in. But that becomes a bit of a challenge.

Jane: Do you think that local content criteria has deterred people from investing?

Nicolas: I think to a certain extent yes. But that being said, people prefer where **(wording unclear)** is a **(wording unclear)** of the business. So where everywhere else in the world booming, SA **(wording unclear)** but at the end of the day, they can't lots of jurisdictions have such a big focus on procurement and region at the moment **(wording unclear)** they do what they need to do to keep their pipeline going and order books busy so the one last thing is that it is uniform across the projects, so not like you say if you are a foreign shareholder in the project you **(wording unclear)** so everybody's in the same boat. I think the people that have the biggest price is the consumer because the cost of procuring funds locally is often more expensive. You essentially bringing cheaper labour from elsewhere and now forced to procure funds locally making it a higher cost and all gets affected in the tariff at the end of the day.

[Closing Remarks]

INTERVIEW QUESTIONS

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Ntombikanina Malinga

Questions

1. Could you please provide me with a bit of background on yourself, specifically explaining your involvement in the South Africa's renewable energy industry?
2. Why do you believe the development of CSP in South Africa (SA) is important?
3. What are the key financial, technology, construction, regulation and licencing challenges of CSP, if any?
4. Does CSP have a high localisation potential – opportunity for a CSP manufacturing sector to develop in SA?
5. What factors do you believe is hindering the involvement of international financial institutions in providing debt finance to CSP projects in SA?
6. What are your views on the economic development obligations of SA's Renewable Energy Independent Producer Procurement Programme (REIPPPP)?
7. What opportunities do you think exist beyond REIPPPP for CSP?
8. What recommendations do you have for the improvement of REIPPPP and for the future deployment of CSP plants in SA?

INTERVIEW TRANSCRIPT

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Ms. Malinga

Ms. Malinga: Hello?

Jane: Hello?

Ms. Malinga: Hello.

Jane: Is this Ms. Malinga?

Ms. Malinga: Yes, how are you?

Jane: Good and yourself? This is Jane Martin speaking.

Ms. Malinga: Hi, Jane. How are you?

Jane: Good, good. Thanks. Does this time suit you? Are you still available?

Ms. Malinga: Yes, I am available.

Jane: Ok.

Jane: Did you receive the questions I sent you yesterday? Did you get a chance to look at them?

Ms. Malinga: No, I did not get a chance to look at them. I'm sorry dear. I'm very, very busy. **[Noise interference]**

Jane: Ok, great. That's no problem. Ok first, I think I will just briefly introduce myself so you aren't talking to a stranger. So I'm Jane Martin. I'm sure you can hear I'm South African. I grew up in Durban and I went to Rhodes University where I did my undergrad and my honours. And then I was fortunate to receive an opportunity to come study at the University of Edinburgh to my Master's in Carbon Finance. My Master's project, the aim is to just to demonstrate at the potential of the concentrated solar power (CSP) in South Africa (SA). Where I decided to use the Bokpoort project, just as a case study to determine the financial viability, identify risks and barriers and also just to get some recommendations. So, I was hoping that you could start things off by briefly introducing yourself and telling me about your involvement in the renewable energy industry and particularly concentrated solar power.

Ms. Malinga: Ok, I don't know how you know about CSP (**wording unclear**) was established in 2010. I think a lot of global associations in South Africa and the whole programmes started up the (**wording unclear**) international commitment and it was captured under Green accord, Which was managed by the Development department (**wording unclear**) and has managed to bring all things together, labour, business, civil society and government under one umbrella. What transpired was the REIPP programme and of course all other associations coming up with there own community and industry body. I joined SASTELA in 2013 as the CEO and I play a role of (**wording unclear**) advocacy. I speak on behalf of all platforms, all stakeholders, I basically interact with everyone in the industry at all levels from international to local players. From project up to community members, industry suppliers, contractors and so forth. However, not everyone is a member of SASTELA so we have a volunteers association so people join when they wish to, we can't force people into that. The few that are there are mainly the ones that founded the association and who believe and understand the long-term objective of ensuring that there are one with clean waters, ensuring that we re-engage with government because its quite ridiculous you have everyone knocking on this big door, but not everyone remember, is a member (**wording unclear**) and other member (**wording unclear**) are not members in SA but we hope they will be, so we constantly engage with everyone in the industry but it's a big challenge.

Jane: Why do you think constraint of solar power is so important for SA? Why do you believe that the development of it is so important?

Ms. Malinga: I think the writing is on the wall, SA is a really key player, not only regionally but also across the whole continent, and globally. Not only are we bestowed with the best solar resource in the world, we are the top I think, but the statistics and all of the studies tells us that the future is in renewable energy. We are going to see it in advance, get cheaper, penetrate more in the market scales and gain more flexibility in terms of small scale as well as much as large scale. And it will have to be supported by things like software and (**wording unclear**) for community to make their own decisions about their own energy, even companies as well can free themselves from the grip of the national grid. Of course all of these are political matters but I think in SA all the evidence shows that it makes more sense to use (**wording unclear**) and available 98% of the year (**wording unclear**) to get the best exposure. And it's also a luxury that it doesn't rain so much, so there really is no explanation. In terms of other reasons we've seen In terms of the procurement process takes long. Power stations are taking way too long to build because of the complexities and political interfering and also the fact that you need to start to look at the mines, to feed into the coal plantation. We both (**wording unclear**) the same power stations as Eskom, which are the better power stations, and we thought (**wording unclear**) so it is ridiculous that government refuses to see the benefit of expanding this as a method of scale given the age of the majority of our weeks, our coal weeks, and that it is going to age, we don't know when, but everyone, you know, believes we can still buy time, and it is the credit match in terms of fee. CSP on a massive scale, and according to the National Development Plan, I don't know if you've seen the study on the website, but I can send it to you, and it speaks to fundamentally

the fact that the NDP is just a corridor of 5000MW in the Northern Cape which would support the industrialisation and localisation of R&D and supply. And, we just shocked by just how slow its being taken on by our government and **(phone relay delay)** our study, which I will send you, we came up with 4 scenarios on how they could be integrated into the character or the ideals and into planning all over the country. And, I think you know by now that the focus is more on nuclear than anything else.

Ms. Malinga: And even with, nuclear, you know we have taken a position where we are not going to be anti anybody we decided that in terms of nuclear, we are also to be the first match in terms of our interrupted benefits, nuclear is a very stable solution and less interruptions and CSP the next best solution when you look at renewable solutions. Not only for just **(wording unclear)** but also for grid coding and grid stability. So we said that even if you want to look at hybrid solutions and so forth this is one of the technologies that present a more solid solution at a larger scale.

Jane: Is that nuclear that you are talking about that a more stable solid solution?

Ms. Malinga: Ya, I'm saying that with nuclear you can pair CSP with nuclear. If you saying that, no we need nuclear because nuclear can give us more energy we saying that the next best could be solar as well (so CSP) because a lot of the other renewable solutions disturb the grid quite a bit and we have been working a lot on grid coding and how to ensure stability that CSP has proved to be the least disruptive. So it makes sense to talk of hybrid solutions and also talk about how we can pair one in terms of more clever mixtures, of energy mixes, if you are not going to take a fundamentalist approach to this.

Jane: I have read somewhere that some have expressed their concerns about investing more in nuclear because to date, I think we've only got 1-2 nuclear power stations in SA, and they haven't been maintained and they do take years to develop. Is there still that concern?

Ms. Malinga: Of course the concern will always be there. The nuclear concerns are quite varied, from safety to environmental concerns and a whole list of other reasons, that is just one of the reasons based on the SA experience. But globally nuclear is not an easy solution to just wrap-up. The energy mix is one that guarantees you massive power output and with the least CO2 footprint, so you would need to consider all sorts of nuclear in order to discover **(wording unclear)** solutions. And, the argument has been that it isn't only used for energy but a lot of other things, from R&D and in medicine and so forth. So its very difficult, but we don't focus on that, we don't focus on promoting nuclear, We just try to show the solutions based on CSP and who CSP can work better with and nuclear was one of the solutions that we demonstrated that in the hierarchy of things, if you want stability of the grid, CSP is one of the most reliable solutions.

Jane: So do you think that despite the introduction of REIPP programme, do you think there is still a lack of political will to invest further in renewables? Or do you think with the programme there was a change in sentiment with the government?

Ms. Malinga: I think the programme was a bit of PR, a stunt, around COP17. The fact that is driven by treasury, the fact that it was measured and very competitive based on price and the whole other issues make it very difficult for local players to participate is not very inclusive. I don't think it was 100% thought out with actual review. And we've asked for a review on those fundamental aspects. One of the **(wording unclear)** ministerial determination that we need to cement the institutionalisation of the whole process. It cannot sit in a minister's office and depending on who is the minister and how they decide the programme can be labelled and die. It's a dangerous way of looking at policies in the government and programmes implementation long term. However that has not been open for discussion, I think you know by now that everything has been delayed from the REIPP revisions to the energy planning national planning programme and so on and so forth. So we are more or less at the mercy of the minister, and then the implementations of REIPP have not made sense as well. Why have they given many more allocations to CSP and given so much more to others? I just think in SA there isn't a real appreciation of what other technologies can do for this region. It amounts to almost crimes against humanity. **(wording unclear)**Part of the world, **(wording unclear)** energy can provide it to the grid, its really sad.

Jane: So to date, what do you think are the key financial; technology, construction, regulation and licensing challenges have been for CSP?

Ms. Malinga: I think the challenges have been funding. Of course for funding, there has been the fact that the projects are quite expensive. You looking gat R10billion for one power station and 100MW and that's not cheap. For locals today, if you have to start this project on your own and you hope to bid and no guarantee that you'd get the bid, you'd have spent anything between R60-R80million just to work on your submission. So it's a very costly exercise. I don't see, maybe one local player, but I don't see many real local players coming in with their own might. You'd have to have a clever funding plan that is supported by government to see that you get more inclusivity for you, more diverse consortiums that we also share in this ownership of this programme. The challenge of curse remains, who owns the energy at the end of the day. And that can bring other issues for the country long-term when the major players are maybe international and the funding comes from outside. We do have funding from the IPC, the SA development Bank and the ITC, PIC and other institutions, but the banks of course, but the chew of the matter is that they may be no more banks, there hasn't been a special programme. A special acknowledgement to really push this against all odds. Its still very much run based on price.

In terms of the rights, of course, this programme gets submission by the DOE. And the developer and the EPC and companies on the consortium have the right to decide on how they are going to cover the binding, the construction, the supplier, contractors, procurement, and so forth. One requirement is that all programmes have to have a local fund with the local people. And that is still under debate because a lot of this programmes are going to overlap and some communities will benefit and other will not benefit. And some will benefit twice if the radius covers them twice from two projects

or three projects. So there is a lot that still needs to be cleaned up in terms of framework for ensuring economic development.

Ms. Malinga: And of course the big question remains the ownership long-term. What is the SA government planning on doing with this programme? What is the long-term vision?

Jane: You mentioned that there is one main SA developer. Do you by any chance remember who that developer is?

Ms. Malinga: Ya its **Omvelo**. I gave you the details.

Jane: How has Eskom responded? Have they been supporting in this whole process because a lot has happened within 5 years, there is a lot going on.

Ms. Malinga: Eskom, I have given you their details, Rakesh is the contact person.

Ms. Malinga: Eskom has been, has had to be committed because as you might remember they are part of the government, as state owned enterprise. So according to the energy regulations, they do participate in a number of ways. One, they have their own CSP project. We still have not seen it coming into fruition (**wording unclear**) not made much progress. I'm not sure about the pricing and what it consists of and so forth. Also, the technology issue that they were advancing power and it's tricky for technology to advance. We do not speak enough about that in terms of the technologies in each one but (**wording unclear**) you will find that in our study as well (**wording unclear**) in the US as well, power is making its way.

Ms. Malinga: So Eskom has participated. Eskom is one of the founding members of SASTELA, so they are a core group of or membership. They are part of the decision maker's board and of course in terms of the grid. Remember Eskom is the one that's going to buy electricity from all these developers and it's quite a bizarre situation. Because on one hand they are playing in this space, but on the other hand they are buying. We had contradictions, the balance sheet does not look so good, and they can't afford to build a grid going forward due to their financial situation, cause of more concern for the country and the programme of course.

Ms. Malinga: I do think that Eskom is a various serious matter that needs to be considered about SA. Obviously we say that the way that its designed as a monopoly is not sustainable and its very important of finding clever ways of making energy plans for the country work and also acknowledge the fact that what we are discussing as the REIPP energy programme, is only the generation side. So we haven't spoken about transmission, we haven't spoken about distribution. There is still a long way to go and even if where there has not had the line, we can come up with an agreement that is called the (**wording unclear**) so the projects to build there own lines but they will have to service them to Eskom because every transmission line belongs to the state. So, it's those tricky situations and it's a serious delay in fact on projects as well.

Ms. Malinga: However there is work on the department and I can connect you with the people working on that or you can speak to Saheed (**wording unclear**) gentleman from BrightSource. He knows about the grid matters.

Jane: Do you think Eskom being the single off-taker the PPA and lack of good connectivity, do you think that that is still one of the main deterrents for investors in SA or do you think that they are not too concerned about that necessarily because the government will be there to pay back if Eskom defaults?

Ms. Malinga: Ya, it doesn't even flight as a concern. It hasn't really pushed people away. Remember we deal with companies, global companies that are in the CSP world that operated in many different countries. These are companies that are operating from your Morocco's to Chile's to Spain, so they've had some level of exposure to different configurations. And SA by far still has quite good infrastructure in terms of grading, there are plans but whether they are fundable or not is a different matter (**wording unclear**) we do talk about the super grade in terms of the SA power pool, which will bring together not just SA but all the neighbouring countries. And also join in big projects like the Inca project, from to the DRC. So the future looks quite exciting and I think that is why this is a growing region in terms of economic development, even though we don't see it seeping down to the low in society but SA is the only growth region in the world and this is why that there is huge potential in this region.

Jane: Do you think there is potential for a concentrated solar power-manufacturing sector to develop in SA?

Ms. Malinga: Yes. Remember in the association we demand that we represent the developers. We represent the manufacturers from steel to glass and so forth. Of course the issues is not a lack of appetite to build these manufacturing capabilities in SA, and not excitingly, the issues are that we would build them in the Northern Cape which is one of the poorest provinces in SA in an extent to create a solar CSP economic zone. Where the entire value chain can be pinpointed there. But when you look at or study you will see that we have taken approach of the airfax model as we call ourselves the southern African solar (**wording unclear**) and electricity association. Our focus is not just SA. We see the integration of efforts into Namibia, Botswana, Zimbabwe, and Mozambique. We hope that in the future there will be centres of excellence in all of those regions. SA doesn't have to be the at all. SA can (**wording unclear**) certain aspects and other regions can satellites certain aspects. We always talk about the physical upticks of things but you need to pay special attention to R&D development, to other non-physical supplier [...] of this project. Like the legal and the expertise need to be shared with the entire region. So yes, and we have started a centre of excellence in Upington to focus on skills development. So yes, there is a lot that we hope to do and the appetite is there. But if you understand the business, it does not make sense to be told we are round 1 and then the science, and then you need to get to Round 2 is coming, and then from Round 3 and Round 4. It doesn't make sense. You want stability, certainty and you want a long-term projection of if I put in this much investment, what is my returns, short-term, medium-term, long-term. The inability of the state and government to give us that, a

projection of what is the plan for this programme long term, makes it very difficult for investors, especially in the manufacturing space. The steel industry is quite competitive globally, if they going to put a plant in SA it better be an objective not only for local consumption but export as well. I understand where they are coming from, the money is there, the interest is there but I can't put my money in a country that doesn't tell what is going to happen next year.

Jane: REIPP is entering its final round. What opportunities do you think exist for CSP after REIPP?

Ms. Malinga: We don't know what will be after REIPP, but I see CSP needing a objective plan like the nuclear programme where you are able to communicate, and again I take this back to the national development plan, were you are able to communicate that we will target 5000MW and this is how we are going to procure for this and this is how we will create economic zones. Remember the power of CSP in South Africa is **(wording unclear)** technology. When I talk to my business people, my technology people, I only say put yourself in the shoes of government. Government has to deal with the legalities, the policies, but most importantly government has to deal with people and communities. So in fact government is not just the advancement of technology but its **(wording unclear)** to our programme, meet government halfway in terms of job creation, in terms of local creation, in terms of all of these interesting aspects of poverty, rejuvenation equality and so forth. Those are very important to keep at the back of your mind and as CSP, is at the for front, a renewable energy solution, because you not in a assembly point like your PV's and so forth. Out components are not built somewhere else. Everything is done exactly the way you built a power station, it's the same concrete, and it's the same fuel. That is a power station from scratch. So the frustration for skills development is huge. The potential for fertilisation is huge and hence we find that the centre of excellence in the northern cape to ensure that the basic skills **(wording unclear)** and so forth start come out where we can move them from project to project and they get better and better on special aspects of this thing. No they are improving. Once they can have a super village of people who can work in other parts of the world. We not just an assembly thing, we can stimulate a real industrial platform for SA and the northern cape and again for me not just the physical manufacturing but the specialised aspects of legal, financing, community development and so forth.

Jane: It seems like an obvious option this.

Ms. Malinga: It's an obvious option but they don't think so. I think they see us but I don't think it appeals to them. I find SA is a country, and maybe it's the politics of this region, for so many years, over 100 years, we never look at the long term. We only focus on the short term and we only focus on a specific aspect of society. We a really elitist society and we only focus on those people. The rest of the people will have to see to finish. We've seen this in the 1800, we've seen this under Apartheid, and we've seen it again in this government. And **(wording unclear)** have to deal with a solution that addresses methods, the masses is not warmed up to. But as long as it gives a few people an ability to cash in, then people get excited. It's actually sad.

Jane: This particular technology in solar in general is in the most poor areas so its such an obvious, it provides energy security, and economic opportunities and also the social, its going to help those masses there.

Ms. Malinga: Competently and even with water use. We've demonstrated that all of our power stations are going to be close cycle power stations. We not going to use much water, the amount of water that will be used will be for the washing of the mirrors. So it doesn't make sense at the number of levels why the excitement is so poor from our government.

Ms. Malinga: But also I think its important, one of the things we are focusing on is how to communicate better. How do we get South Africans understanding this technology and getting excited? At the end of the day the people vote, the constituencies are the ones that force decision making from the politicians so maybe if we spend a lot of time educating them, they go to school, universities and so forth, and try to get the message out there that people can start getting excited about this. I'm talking to a company in the US who I'm trying to, there is a young person in the township, who cannot further her studies, yet she's focused on physics, and her focus is on battery development which is going to be he for renewable energy. Trying to further the Silicon Valley, to say, here is someone who knows Africa, but can she work with you to find solutions. At the end of the day they don't have to be custom made for this region. Lets start getting more young people, more journalists, more finance student excited about this technology and maybe we can start seeing some momentum.

Jane: One of the economic development obligations criteria is that these projects need to provide a certain amount of benefit to the local community. When will these people receive these benefits? Is it up to the developer or do they have to, does the developer have to provide these benefits at the beginning of construction or only after once in operation?

Ms. Malinga: Nope. I think they have started from construction. I think when you speak to the **(wording unclear)** people, they can give you their presentation on this. They did a presentation, we took the main star of DTI, last year to they're **(wording unclear)** and to the community and this is the one of the aspects spoken about. How it has started to do a lot of **(wording unclear)** programmes in the region, a lot of employment a lot of training. A number of aspects of the storage system is manufactured locally so I think there is already a footprint, but remember, in terms of the actual dividends that the community, I think that will come in once the build has been commissioned.

Ms. Malinga: And of course then you have to as a student, to get a comment, in terms of the integration of decision making, this project was very to down, national government. They paid into departments, but now remember the project is happening at local level so it's not just a clever integration and sophisticated way. We just need to have a policies translated from national to provincial to local, but its also each policy or each departmental work which needs, have to deal with the department of energy, the department of water, the department of health and its at a local level that they not working to get by, it's a nightmare. There are a lot of land affairs because you have to

buy this land and procure these leases and so forth, so there are a lot of departments involved. But most critically, the power is with the decision-making parties. You now have a province that is not happy with all this taking place in their own province, they not the major decision makers, they are the **(wording unclear)** so stakeholder engagement is very important at all levels and they going to inherent this. And how does this link, how does the national development plan link with local IDPs, in terms of integrated development plans at provincial level and local level. How are these supposed to work? I feel frameworks, they can't be thumb sucked. Some one has to sit down and work on it, propose something, learn some best practice.

Jane: The programme is very complicated with the coordination between these departments and at the different levels. It's amazing that it has been able to achieve so much but it's just really complicated.

Ms. Malinga: I would say that we haven't achieved much. For me, I think we could of achieved more. I think we have been very much operating at a mediocre level where we have just done enough where it looks like we have done something globally and everything. But I think if we were very aggressive, we would of done stuff especially with an opportunity, every crisis has an opportunity, with the energy savers in SA. There is no reason why this is not the best time to explore CSP. And cover the gap creatively, but it's not the reality.

Jane: In the future which technology do you think we will see more of? There is more PT cause it's the more mature but there is also a lot being invested and research done on tower.

Ms. Malinga: There is research on tower. There I would like you to speak to the developers and get a more technical and up to date perspective on what are the trends, what does it look like, is it driven by the maturity of the technology, or is it drive by the financial modelling. Is the tower going to be more expensive or cheaper? And now we going to deal with the global, **(wording unclear)** NGO **(wording unclear)** the tower growing concern, so I haven't though t about which one will overwrite the other but you can ask those people. At the moment projects have been chosen and have been decided based on finances and technology. And remember that it's the financing, or main financing body is very much the EPC kind of consortium but will of course have there own technology.

Jane: What recommendations do you have for the improvement of REIPP? And also for the improvement for the deployment of CSP?

Ms. Malinga: I think one is allocation, allocation, and allocation. There is no reason why in a region that does not have greater location of CSP over and above all other technology, it just makes sense. And the benefits, fine it may be expensive now but long term compare a coal a power station and then compare apples to apples. Environmental footprints and everything and power statin last as long as any other power station so it really doesn't make sense. And also in the sense of the whole value chain of CSP and the benefits of the technology to the sustainability, but also in the sense of the country and for me that needs to be paid more attention to.

Ms. Malinga: In terms of the REIPP programme, as I said it needs review. I think we need to talk seriously about the top down approach; we need to talk about integration at all levels of government. We need to talk about integration into government. Levels we need to talk about the next **(wording unclear)** [...] of determination. We need to talk about not just generation but transmission and distribution. And talk about Eskom. Eskom has taken the entire programme. We need to talk about inclusivity, how we get the marginalised people participating, getting South Africans participating, and where is this money going to come from. So is going to help kick start the diversity of the ownership. Of tis fate, you don't want another marikana in this instance. And we need to be more, better decision-making. We don't have, for example, a platform that allows us to meet government, get feedback, get updates, to understand what there thinking is, where we think they are going. We do need a country mark a plan and its not there. We don't only need an energy plan, but an industrial plan or whatever, those modernisation plans. You can't just have electricity for electricity sake. What industry is supposed to start? What it is supposed to be the backbone of. So there are very broad questions that don't allow you to get a full picture of where this thing is going [...] translating to your own state.

Ms. Malinga: No women in the space. Where are the women? But fundamentally I think south Africans, we need to make more effort to get everyone excited about CSP and understand what it is and develop own our local expertise at the same time.

[Closing Remarks]

INTERVIEW QUESTIONS

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Frank Dinter

Questions

1. Could you please provide me with a bit of background on yourself, specifically explaining your involvement in the South Africa's renewable energy industry, specifically CSP?
2. Why do you believe the development of CSP in South Africa (SA) is important?
3. Can CSP with storage compete with other baseload technologies such as coal-fired power stations and nuclear energy?
4. What are the key financial, technology, construction, regulation and licencing challenges of CSP, if any?
5. Do you believe that tower technology will be the utility-scale technology of the future, or do you believe that parabolic trough will continue to dominate, specifically in SA?
6. Currently and/or in the future, which renewable energy technologies are likely to be CSP's major threat/competitor?
7. Do you believe that there is an opportunity for a CSP industrial/manufacturing sector to develop in SA?
8. What factors do you believe is hindering the involvement of international financial institutions in providing finance to CSP projects in SA?

- 9.** What are your views on the economic development obligations of SA's Renewable Energy Independent Producer Procurement Programme (REIPPPP)?
- 10.** What opportunities do you think exist beyond REIPPPP for CSP?
- 11.** What recommendations do you have for the improvement of REIPPPP and for the future deployment of CSP plants in SA?

INTERVIEW TRANSCRIPT

Dissertation Title: The Potential Role of CSP in South Africa: A Case Study on the Bokpoort CSP Plant, South Africa

Interviewer: Jane Martin

Interviewee: Professor Frank Dinter

Frank: Sorry, I'm back. Sorry.

Jane: No problem. No problem.

Frank: Someone is calling from the capital and it is always important.

Jane: [Laughs] From which capital?

Frank: He is calling from Johannesburg. It's not the real capital, but it's the business capital here in South Africa (SA).

Jane: Yes, it is.

Frank: I just saw that number and was like 'Ok, I have to answer the phone.'

Jane: Yeah. No problem.

Frank: But now, no one should disturb us again.

Jane: Ok, great. Thank you again for making some time available for today cause I know you have just gotten back from your holiday and I'm sure it is very busy with the start of third term.

Frank: That's right. It's always like this when you come from holidays. Well uh it has already been some very long days this week.

Jane: Oh, gosh. Is university already back?

Frank: Well yes here everything is on track. All the students are here, we have many exams, there is a lot of things to do. We are preparing a CSP conference because the Solar Bases conference will be held in Cape Town in October.

Jane: Oh really?

Frank: We are very much involved with this.

Jane: Who is hosting that conference?

Frank: Solar bases conference at the International Conference Center in Cape Town. So we expect about 800 people.

Jane: Wow. Is it from fields? Developers? Institutions?

Frank: Yes. And all the researchers. Everyone is coming together on that conference once a year. Last year it was in Beijing, the year before that it was in the US, in Las Vegas. And now we are in Cape Town.

Jane: That is exciting. Exciting times.

Frank: I think it's a very good time because CSP is real good technology for SA and so we really set a point that everyone is coming down here. And what are you doing for Bokpoort?

Jane: For my master's thesis I'm actually—I'm exploring the potential for concentrated solar power (CSP) in SA. And I decided to use the Bokpoort project as a case study just to analyse, to determine the financial viability of CSP and calculated the device cost of electricity. And just to identify the risks and barriers, not specifically for that project, but for CSP in general too.

Frank: Ok, and Edinburgh University is really working on CSP because your country don't probably have enough sun for it.

Jane: No, no. I'm doing my master's in Carbon Finance, so it's energy finance renewable, low-carbon technologies. I decided when I return back to SA I would like to get involved and work in the renewable energy industry. So that is why I decided to look at the new renewable energy IPP program and to focus on this technology. Because I really believe in it and I think there is great potential in SA.

Frank: You are South African?

Jane: Yes, I am South African.

Frank: Ah, very good.

Jane: Actually, I grew up in Durban and did my undergrad at Rhodes University in Environmental Sciences and Economics. And I did my honours in Economics. And then I came across here to do my master's here.

Frank: Ah, ok. Where did you do your undergrad?

Jane: At Rhodes University.

Frank: Rhodes?

Jane: Rhodes University in Grahamstown.

Frank: Ah ok, yes. Sounds good. Okay!

Jane: I was wondering if we could just start things off by you briefly introducing yourself and giving a bit of background.

Frank: Ok, well—

Jane: Sorry, before we start did you manage to—did you have a chance to look at the questions I sent you?

Frank: Yes.

Jane: Ok, good.

Frank: Yes and I have some ideas to answer.

Jane: Ok, great. And would you mind if I recorded this? Just for note taking.

Frank: That's not a problem.

Jane: Great. Thank you. Okay. So if you could just briefly introduce yourself and give a bit of your background in CSP and thermal storage.

Frank: I studied energy and power plant technology at the University of **(wording unclear)** in the 80s and wrote already my diploma thesis at **(wording unclear)** in southern Spain on thermal storage systems and also did my PhD thesis on thermal storage for CSP plants for big CSP plants. In this time the CSP plants in the US were developed and I created some storage systems with for these CSP plants so I started with CSP very early in my life. But then I worked for more than 20 years for a utility in Germany and I stepped back to CSP in 2008 when I became the technical director of a CSP plant in Spain during construction and operation time. So I was the head of solar at the IWE energy, it's a renewable company of the IWE utility in Europe and we bought one of the 50 MW CSP plants from project developer and then we started to construct it and operate it. And since 2 years now I am a professor at Stellenbosch University, I got the Eskom Chair in CSP and I am the director of the Solar Thermal Energy Research group here at Stellenbosch University.

When I started with solar technologies in the 80s I had some similar feeling in Spain, almost 30 years ago, when I compare it with the Cape area at the moment. So it's also a Mediterranean climate but the sun is shining even better.

Jane: Why do you believe the development of CSP in SA is so important and has such great potential?

Frank: First, SA is one of the best sunspots on earth. If we cannot make it here with CSP, we probably cannot make it anywhere. So it's the best large scale renewable technology you can get and it is dispatchable because you have storage systems and it's proven that CSP plants can deliver 24 hours a day. That has been proven plenty of times in Spain and other countries. And so I really believe that here in SA, CSP has the best chance of a step into electricity production in large scale.

Jane: Do you believe that it can compete with other base load technologies, such as nuclear and coal fired power plants?

Frank: I think that CSP is already cheaper than nuclear power and less dangerous, much less dangerous. You have a lot of coal fire power stations, where lots of jobs are related to coal-fired plants and mining, but on the other hand, if you look at carbon emission and air pollution and something like this you really have to think about using renewable energies in the future. From my perspective, the costs are coming down more and more and you can already see that in the different bidding rounds here in SA where we started with about 2.6R per KW hour and now we are around 2.5 for CSP. Of course, PV and wind are still lower but in this case it is not dispatchable energy. You cannot deliver on demand; you cannot support the grid here in SA. The National, electrical transportation grid and so everything, this is possible with CSP but not with other renewable technologies so far. Therefore I really believe that CSP has a big chance.

Jane: Why do you think the SA Gov. is pushing more for nuclear? Do you think it's a more political game?

Frank: Yes. It is a political game. And also I think, or what I hear from the companies here, who are installing CSP that they are not going to ride anybody or put money on the table for getting the project, they offer their technology and make correct deals and I don't know if it like this with nuclear, the technology, because we have so many information in the news that the Russians are doing more than only offering technology. I don't know how to explain that because I am a foreigner in this case.

Jane: What are the key risks and barriers facing CSP in SA?

Frank: The challenges we have are that, if you want to build many CSP plants or what to get CSP local, you need a pipeline of power stations. So if, for example, the glass manufacturer should produce low-iron glass, which is possible in SA, because P&G glass has said not a problem, we can do that but we need a certain amount of orders, and so that is the main issue. If you want the industry doing something you really have to show them there is a future in this technology and that we have a pipeline of projects coming. So then the people would install factorises and produce something in SA directly and its not necessary to import it from Spain, or Europe or the US or anywhere else, or China.

Jane: Do you think one of the main challenges is the uncertainty of demand and the future of the technology?

Frank: I think if the government would really write down a plan and say, we would like to have so many Gigawatts in CSP, many companies here in SA would jump on it and say yes, now we see the future in CSP and its not only buying from Spaniards. That is something else and when you can produce in your own country, the costs will go down and you will have labour, you will have jobs, and all these things will come up. And In my opinion, South Africa could become a real CSP nation who exports CSP to other countries because they can make the experience and they have the sources in their country. So for me it is a no-brainer. But I would say yes lets do it.

And maybe I should also say that regulations for example, if you always compare it to the costs of electricity in SA and you compare it to old coal fired power stations, then I think that is wrong to do it like this. In my opinion, you have to compare it to new coal fired power stations because CSP plants are also new and if you compare all the costs for coal fired power stations, including the coal, so the fuel for the years and if you put everything together, a CSP plant is already cheaper than a coal fired power stations, And if you compare it just with the costs of a nuclear power stations, it's also already cheaper.

(Question 6) I think that gas is cheap and easy to handle and gas power stations are also quite cheap but you are dependent on gas. If you now think about fracking for example in SA or getting gas from anywhere else, you are dependent on the suppliers or you destroy your own country as many people did in the US and the US didn't care about destroying the country or the soil or pollute the soil and so on, and I wouldn't do that, I would for SA, there is such a big chance to jump directly to renewable energy at the moment and all the other industries, like gas and oil and coal mining industry and they all want to earn money but on the other hand, SA has such a great possibility to use renewable energy like wind and solar I would say directly go for renewables.

And another competitor for CSP of course is PV and wind on the renewable side, because they are much cheaper at the moment but they have no storage and so without storage when you always have to calculate a storage system with PV and wind when you want to compare with CSP. And if you put this money for storage system, it could be hydropump storage, or it could be battery in the future, if you use something like this, you will be much more expensive than a CSP plant. So for the future, for me, the real solution in CSP.

Jane: When comparing costs, if they take that storage it would be completely different.

Frank: Right, therefore I let some students do work on that to compare such technologies correctly.

Jane: I've heard that there is a lot of research and development on PV and battery storage. Do you think that that could be a technology of the future and one of CSP's main competitors?

Frank: I would say yes, in a certain area. You always need large-scale power stations to feed in the national grid and to supply industry and the like. But for example, for residential and rural area, I think PV with batteries could also have a chance. And if the Chinese or the Far East really develops batteries with long life and reliable and easy to install then I would say it's a good chance but the price for batteries is still very high. Here a lot of development has to be done and afterwards I would say PV, wind and batteries could become a real rural energy supply.

Far from grids and maybe on areas where it is hard to get fuel or something it's a good idea to install islands with batteries and maybe PV and wind just to supply the people there with electricity.

Jane: Do you believe that tower technology will be the utility scale technology for the future? Or do you think that parabolic trough will still dominate?

Frank: That's a really nice question. I would say it depends. Everybody say what is better tower or troughs? And I say, OK, the proof in technology at thermoset is through with oil as heat transfer fluid up to 400 degrees. This is not the optimum. And the technology more or less is there it can be built easily and copied and paste. Everything is under control and everybody understands the technology now. But on the other hand I would say the towers have the advantage, the future towers, use molten salt and molten salt is heat transfer fluid, which can handle higher temperatures. And that is very important for the turbine efficiency to have a high inlet temperature. Because the efficiency is dependent on the temperature difference from inlet to outlet. So if you increase the inlet temperature than you have a higher efficiency on the turbine and of course mean you have a higher output. So you need another heat transfer fluid for troughs to be competitive with the efficiency and so if we can use molten salt also in trough and not use the oil anymore, the troughs are competitive to towers. And we here at Stellenbosch University, we work on other heat transfer fluid like air in tower receivers. So if you heat up air, and air is available, is very cheap, you just take it. And you heat up the air and with this air you heat up maybe rocks because rocks are everywhere all over the world and you could use rocks as storage. As a form of thermal storage. And we are looking for really simple and cheap systems like air receiver and rock bed storage and then you blow cold air through the rocks again to discharge the storage and with this hot air **(wording unclear)** So first from the receiver you get hot air to heat up the storage. And then you can also go directly with the hot air to the receiver and produce steam. And during night time you just take cold air, get it heated up by the hot rocks, and this hot air now coming from the storage can also run heat exchanger to produce steam, and so the steam turbine could run 24 hours a day. And that is the technology that Stellenbosch University is working on and we call it the sun spot cycle that means Stellenbosch University Solar Power Technology. That as developed here some years ago and we are really still working on air receivers and rock bed storage and we also present on the conference in October about these technologies.

Jane: Do you think a CSP industry is possible?

Frank: Yes, I think industry is possible. And I can tell you that we already have a spinoff company which was funded by TIA, the technology agency here in SA and they funded a project for constructing helio studs and develop and construct helio studs and now we have a group of engineers, about 12 engineers working in the company and they really build the first totally SA solar field for central receiver system. And that is something, which is possible here in SA. And that is why I really believe that SA could become a CSP nation and a supplier for other countries in this game.

Jane: What other areas do you think SA, within the manufacturing industry, could really tap into other than making these helio stats? For example the boiler companies could also create receivers and they know how to weld pipes and they know how to handle different pressures and materials **(phone loses connection)**

Frank: And also the steel structure for helio stats and also for troughs is something, which can be done easily in SA. Also all the construction work I think is already done. I spoke to one of

the EPC contractors in SA who built a CSP plant and they said they have about 100 suppliers already from SA, but the main parts, like bended glass or low-iron glass even steel structure came from Europe because it as cheaper to have it from them than to buy it here from SA.

And of course that is something that if the industry does not see that thee is a future for something like this then of course the SA industry, oh no we supply the mining industry, or we supply them or them, and you could be a new customer but you have just one project. You have to show me a pipeline. And then we can give you good prices and discuss. But if you don't and just come here and want to build one plant and want the cheapest price I can give to you then its probably not the same price that Eskom would get.

Jane: Do you know anything about the financing of these CC projects?

Frank: I don't know too much. The IDC stepped in and that there are high interest and everyone wants certain return on investment and the risk in SA is a little bit higher because you are inflation rate here is higher than elsewhere. So the financial costs are little bit higher than in other areas.

Jane: Have you heard of any reasons why international companies are hesitant in providing finance?

Frank: I think it always necessary to have local banks because the locals should believe in this technology and if locals banks asked for credits from international banks, I think that is a good idea, but you always need a certain amount of local bank into it and I think that the challenges really is the inflation rate and how to manage if the exchange rates and something like this and therefore it is always good to have it locally and not internationally. That would be my perspective.

Jane: How familiar are you with the renewable energy IPP programme in SA? The economic development obligations of it?

Frank: Yes I know the programme and the different rounds and what is required and going on there. But I think it's a good idea not only let Eskom do it, because Eskom is also a big utility and state owned and very conservative and have many people. And the independent power producers are smaller companies with fewer overheads and so they probably can do everything a little bit cheaper than Eskom could do it. And so you get competitors in electricity production from my perspective it really makes sense e to have a kind of unbundling of grid operation and power production. So, that independent power producers get power purchased pre-agreements, maybe even you tell them you have to deliver in peak hours. Or certain power stations have to deliver at this certain time during the day just to get it even out the demand here in SA.

Frank: And as you can see with Eskom they have many problems with the new power statins to get them connected to the grid because there were many technical problems and they probably overtook a little bit and over screw a little bit what they wanted to build and I believe that that was a mistake but they noticed it. And now with independent power

producers and the REIPP programme it is much easier to produce electricity and you really can see already in the different routes, the prices are coming down and for me it's a quite good idea to open the market in this case.

Jane: Do you think the programme was ambitious enough?

Frank: Have the feeling that the department of energy and also the international office for integrating these renewable projects. At the beginning they paid much too much to the developers and the EPCs in this case but now it's becoming better and nearer to the real price. In PV and wind and also CSP. And I still believe that if the department of energy would understand better what CSP can do for the grid stabilisation and for energy production, they probably would also require different supply schedules and with this they really can perform much better for the grid and for the demand for electricity in SA. I think it's just a lack of knowledge at the DOE and maybe they also have, I doubt they really on some consultants but they are just working for PV and wind and CSP lobby is quite bad here in SA still.

Jane: After this programme what do you think the future of CSP is?

Frank: This is exactly what I said before. If you want to become a CSP nation and want to be technology provider in this case you really need this pipeline and you have to create own knowledge in the country and this is the reason why this CSP chair I got here at Stellenbosch is created because engineers in SA should be educated as solar engineers and so with my experience from industry I came here to teach them and show them how these power plants work and how to construct what are the problems, the challenges and the solutions at the moment and just motivate them to be creative and think about other solutions, cheaper technologies and put them together into a system of optimisation for CSP to get the price for the electricity production down with CSP technology. I think this is exactly the right way. Here in SA you really need a test and training centre for CSP where you can test different components. Where you can test different materials, and technologies and educate and teach people like workers, technicians and engineers to be prepared for this technology for the future.

Jane: Do you think the future for this technology looks good?

Frank: I don't know if the government is doing that. I would wish that they do it and understand that this technology is really the electricity large-scale production for the future. I really hope and cross my fingers for that but I don't know how the government is going to decide, and sometimes wrong people are at the wrong place and sometimes you are lucky you write the person at the right place at the right moment. It is quite hard to say and I can only say that I wish that they understand better the technology and push it forward.

[Closing Remarks]

Appendix 3

Bokpoort 50 MW CSP Plant Input Data

Input Data		Source	Assumptions
Debt	71%	Boyd et al (2014)	
Interest paid on debt/year/20 year PPA	12%	Baker (2015)	
Equity (ordinary Shares)	29%	Boyd et al (2014)	
Return on Equity	17%	Papapetrou 2014	
COSTS			
Investment Costs (USD\$ millions)			
Solar Field (38%)	214,7	IEA -ETSAP and IRENA (2013)	Assume capital allowance applies
Thermal Storage (11%)	62,15	IEA -ETSAP and IRENA (2013)	Assume capital allowance applies
Power Block, BoP, Grid (14%)	79,1	IEA -ETSAP and IRENA (2013)	Assume capital allowance applies
Labour (17%)	96,05	IEA -ETSAP and IRENA (2013)	
EPC, Financing and Licensing Costs(20%)	113	IEA -ETSAP and IRENA (2013)	Assume capital allowance applies
Total Project Costs (Initial capital) (USD\$ millions)	565	ACWA Power (2015)	
			Split equally over the 2 year construction period.
OPEX			
Operation and Maintenance Costs (USD/kWh)	0,03	IRENA (2014)	
Insurance (% of Initial capital costs/annum)	0,5%	IRENA (2014)	
Additional Costs			
% of annual revenue to flow to local community	45,00%	UNFCCC(2012)	
Decommissioning Costs (% of Initial Capital)	250,0%	IRENA (2015)	No data found on decommissioning costs for CSP. However, assumed to be similar to offshore wind which holds similar risks and is a technology still in its infancy. Assume capital allowance applies
Corporate Income Tax Rate on Annual Revenue	2800,0%	SARS (2014)	Assumed to be Corporate Income Tax Rate used
REVENUE INPUT VALUES			
Gross Capacity (MW) per turbine	54	ACWA Power (2015)	
Net Capacity (MW) per turbine	50	ACWA Power (2015)	
Electricity Generation (MWh/yr)	224 000	NREL (2015)	
Thermal Storage (Hours)	9,3	ACWA Power (2015)	
DNI	2800	SolAfrica Powerpoint (2013)	
Tariff (USD/kWh)	0,22	Papapetrou (2014)	USD/Rand Exchange Rate: R11
PPA Term (years)	20	ACWA Power (2015)	
Avoided Emissions tCO2e / Year	200 000	UNFCCC (2012)	
CER Futures Price(USD)	0,54	ICE (2015)	
CER Crediting Period (years)	10	UNFCCC(2012)	
ADDITIONAL INFORMATION			
Discount Rate (%)(Nominal)	8	Tomascheck et al (2015)	Assumed this is nominal, need to change to real rate.
Discount Rate (%)(Real)	2,369668246		
Hours in a year	8760		

3.1. Discount Rate Assumptions

In times of inflation, the fund providers will require a return made up of two elements:

1. Real return for the use of their funds (i.e. the return they would want if there were no inflation in the economy) additional return to compensate for inflation.
2. The overall required return is called the money or nominal rate of return.

3.2. Tax Rate Assumptions

- Impact of taxation on the discount rate used when calculating the WACC, the cost of debt should always be a "post tax".
- Impact of taxation on cash flows
- Taxation has the following effects on an investment appraisal problem:
 - Project cash flows will give rise to taxation which itself has an impact on project appraisal.
 - Organisations benefit from being able to claim capital allowances (WDAs) - a tax deductible alternative to depreciation. The effect of these is to reduce the amount of tax that organisations are required to pay.
- In practice, the effects of taxation are complex, and are influenced by a number of factors including the following: the taxable profits and tax rate, the company's accounting period and tax payment dates, capital allowances, losses available for set-off, but many of these issues are ignored or simplified for the purposes of NPV investment appraisal, Capital allowances/WDAs .
- For tax purposes, this project may not deduct the cost of an asset from its profits as depreciation (in the way it does for financial accounting purposes). Instead the cost will be deducted from taxable profits in the form of 'capital allowances' or WDAs.
- The basic rules are as follows:
 - WDAs are calculated based on the written down value of the assets (this will either be on a reducing balance or straight line basis), the total WDAs given over the life of an asset equate to its fall in value over the period (i.e. the cost less any scrap proceeds)
 - WDAs are claimed as early as possible

- WDAs are given for every year of ownership except the year of disposal in the year of sale or scrap a balancing allowance (BA) or balancing charge arises (BC).

3.2.1. Capital allowances/WDAs

Source: SARS (2013)

- Plant and machinery: Year 1 = 40%, year 2 = 20%, year 3 = 20%, year 4 = 20%
- Industrial Buildings: 5%pa
- Renewable Energy Allowance Section 12B: Year 1 = 50%, year 2 = 30%, year 3 = 20%
- Section 12B (1)(h) provides for a deduction in respect of any machinery, plant, implement, utensil or article (referred to as a qualifying asset), owned by the taxpayer and brought into use for the first time by that taxpayer for the purpose of trade to be used by that taxpayer in the generation of electricity from renewable energy (i.e. wind power, solar energy, hydropower and biomass).
- These are realised from the first year the assets are used in production.

3.3. Sensitivity Analysis

3.3.1. Capital Cost Reductions

- Overall Capital Cost Reduction
- Overall capital cost reductions for parabolic trough plants by 2020 are estimated to be between 17% and 40 % (SBC Energy Institute, 2013; IRENA, 2012).

3.3.2. Discount Rates

- Varies between 6% and 13% given the risks associated with it (SBC Energy Institute, 2013).

3.4. Further Assumptions

- Solar Field: Assume capital allowance applies
- Thermal Storage: Assume capital allowance applies
- Power Block: Assume capital allowance applies
- EPC, Financing and Licensing Costs: Assume capital allowance applies
- Total Projected Costs: Split equally over the 2 year construction period.
- Decommissioning Costs: No data found on decommissioning costs for CSP. However, assumed to be similar to offshore wind, which holds similar risks and is a technology still in its infancy. Assume capital allowance applies
- Corporate Income Tax: Assumed to be Corporate Income Tax Rate used
- Tariff (USD/kWh): USD/Rand Exchange Rate: R11
- Discount Rate (%)(Nominal): Assumed this is nominal, need to change to real rate.

