CLIMATE POLICY INITIATIVE

The Role of Public Finance in CSP Case Study: Eskom CSP, South Africa

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San Giorgio Group Overview

This paper is one of a series prepared by Climate Policy Initiative for the San Giorgio Group, a working group of key financial intermediaries and institutions engaged in green, low-emissions, and climate-resilient finance. San Giorgio Group case studies seek to provide real-world examples of how public resources can spur low-carbon and climate-resilient growth, what approaches work, and which do not. Through these case studies, which share a systematic analytical framework, CPI describes and analyzes the types of mechanisms employed by the public sector to catalyze and incentivize private investment, deal with the risks and barriers that impede investment, establish supporting policy and institutional development, and address capacity constraints.

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Executive Summary

Among the low-carbon energy technologies available, concentrated solar power (CSP) is of particular interest since, when combined with heat storage, it allows CSP both to supply steady base load energy and meet the growing demand for peak load provision, helping to maintain energy system stability and making CSP a useful complement to fluctuating supply from other renewable energy sources. Despite its potential, CSP technology lacks a long deployment track-record and still comes with high technology cost and risks. This means that most projects need public assistance in the form of low-cost public finance or political support to be bankable.

Among emerging economies, South Africa has particular potential for CSP because of the country's excellent solar resources. Currently South Africa relies largely on carbon-intensive coal generation for power but CSP offers a scalable alternative to diversify its future energy mix. However, to date the country has one of the lowest renewable energy penetration levels of any major economy. In order to increase energy security and meet emissions reduction targets, South Africa aims to add 20 GW of new renewable power generation capacity by 2030, of which 3.3 GW is expected to be CSP. This would double the current installed capacity of CSP worldwide.

This case study examines the 100 MW Eskom CSP power tower plant in Upington being developed by Eskom, South Africa's national state-owned electricity utility. Incorporating 9-12 hours of thermal energy storage and a dry-cooled steam cycle to minimize water usage, Eskom CSP is one of the most ambitious and technically challenging CSP power tower projects under development outside of the US. As such, it has a higher potential for cost reduction, building up local supply chains and promoting energy security than other CSP project currently under development in the country. The project is also interesting from a public finance perspective because of the key role that international finance institutions (IFIs) have played in its financing so far.

By analyzing in detail what worked and what did not in the project's financial, political and technological risk management, this case study can inform the efforts of public entities such as national governments and the Climate Investment Funds (CIF) to design national and international public finance programs to deploy CSP and other emerging technologies.

Low-cost debt lending from IFIs and balance sheet finance from Eskom enabled the Eskom CSP project to proceed

Early designs for Eskom CSP were discussed in 2003. After several years in development, the project was placed on hold in 2009 during the global recession, largely because reduced access to capital and increased pressure from the Government of South Africa to improve the country's energy security at low cost led Eskom to reassess its investment priorities. In 2009, the Clean Technology Fund (CTF) assigned USD 500 million in concessional financing to South Africa for clean energy-related investment, 60% of which was targeted at CSP. The investment plan allocated significant funding to Eskom CSP and thus put the project back on track.

Our analysis suggests that each project stakeholder plays a particular role in the financing to ensure that project development can proceed.

Six IFIs[1] have committed to provide USD 995 million in highly subsidized debt. This allowed the project to proceed while lowering the financing costs. Multilateral bank loans are currently being issued at less than 2% in foreign currency terms, while local currency commercial loans for CSP projects in South Africa are closer to 12%. IFIs' loans were essential because electricity from the Eskom CSP plant will be more expensive than other fossil fuel and renewable options and is expected to far exceed the rate Eskom can reclaim from customers through electricity tariffs. Because Eskom is subject to regulatory control and public spending laws, it can only charge customers a predetermined amount.[2] This has to pay for the capital expenditure, operating and maintenance costs (including primary energy) of its own power plants and its power purchase agreements with independent power producers (IPPs). However, the estimated levelized cost of electricity for CSP (0.28-0.33 USD/kWh) is higher than for other technologies such as hydro (0.06-0.13 USD/kWh), new coal (0.08-0.16 USD/kWh), or open cycle gas turbines (0.14-0.24 USD/kWh), making Eskom CSP financially challenging.

By developing the Eskom CSP project 'on balance sheet', Eskom can reduce the cost of financing and cover substantial risks. Should there be a financing

1 Including Clean Technology Fund, International Bank for Reconstruction and Development, African Development Bank, Kreditanstalt für Wiederaufbau, Agence Francaise du Développement, and European Investment Bank.

2 Currently the company can charge an average 0.08 USD/kWh in 2013/2014 (Multi Year Price Determination (MYPD 3)).

gap between project cost and IFIs lending, Eskom will finance the gap on its balance sheet. Balance sheet finance already enabled Eskom to raise capital more cheaply than through alternative options such as external sources of equity or commercial debt. Once the company receives the loans from IFIs, balance sheet finance will also help Eskom to internalize the foreign exchange rate risk from raising low-cost foreign debt since Eskom has experience and the in-house capacity to manage foreign currencies in the company's investments. Experience gathered from developing other CSP plants in South Africa indicates a100 MW CSP power plant with less storage than Eskom CSP can be expected to cost USD 1 billion investment (including debt). The investment cost of Eskom CSP can be expected to be even higher due to its longer storage capacity. Configuration, lessons learnt, and risk sharing mechanisms will contribute to the ultimate pricing.

Eskom CSP is fully publicly financed. While it is not unusual for CSP projects to have large public contributions (given the high costs and technology risks), the 100% public financing nature of Eskom CSP is different from other CSP projects in the country and beyond, where private actors contribute to project finance.

Contracting companies with additional expertise helped manage technology risks arising from Eskom's lack of in-house experience

As South Africa's national electricity utility, Eskom has many years' experience of developing large and capital-intensive energy projects, but it is relatively new to non-hydro renewable energy investments. Eskom has addressed and will address risks from this lack of in-house experience with CSP by contracting two parties during the following key stages of the project: design, construction, and early operation.

- **Eskom has brought in expert design services from outside the organization**. Eskom contracted an Owner's Engineer (OE), an engineering design consortium that has optimized the project concept and basic designs and increased confidence on costs and feasibility. In this way, Eskom benefited from external expert advice on all aspects of the project's development stage.
- **Eskom will reduce technology risks through an engineering, procurement and construction contract**. Eskom is in the process of procuring a full engineering, procurement and construction (EPC) contractor for the construction and early operation of the project. The contractor will procure the necessary technology, arrange contracting, warranties and any sub-contracts, construct and commission the plant, then operate the plant for five years while training Eskom staff for the handover and minimizing any integration risks. Eskom will contribute expertise on connecting the plant to the grid.

If successful, Eskom CSP could provide important benefits such as technology cost reduction, job creation, and energy system benefits

Eskom CSP is expected to provide greater potential to bring technology costs down and create local supply chains than any other CSP project currently under development in South Africa. CSP power tower technology looks set to become one of the dominant CSP technologies in the coming years, while to date only 500 MW have been built making Eskom CSP an even more significant project. The 100 MW generation capacity and the technology configuration selected for Eskom CSP is expected to provide a higher cost reduction potential than smaller installations in the country. Increased skills in planning and installation, operation of a power tower plant, as well as the establishment of a local supply chain and infrastructure should lead to cost reduction of CSP in South Africa. Furthermore, developing a local supply chain is a primary objective of South African policymakers and public lenders since it creates local jobs and improves the region's wealth.

Eskom CSP provides the most storage capacity with the highest volume of delivered energy of the CSP projects currently under development in South Africa. It should therefore deliver the biggest energy system benefits. The value of energy storage managed by the energy system operator is that it can be used at any time to alleviate supply shortages or avoid use of more expensive electricity generation especially at peaking times. If Eskom CSP is a success and accompanied by a significant reduction in CSP technology cost, its innovative technology configuration could be replicated in the country and further afield.

While enabling Eskom CSP, foreign debt from IFIs results in additional challenges, which Eskom has to manage. Addressing these challenges can lower costs and speed up implementation.

Foreign debt from IFIs played a big role in enabling the Eskom CSP project to proceed. However, it also brought additional risks that Eskom had to manage. We found a variety of ways in which these issues could be addressed and outline them in the table below.

RECOMMENDED APPROACH	CHALLENGES IT ADDRESSES
Technology context. IFIs can help to ensure that projects contract the most suitable, experienced and cost competitive technology and service providers by adapting procurement standards appropriate to a technology's stage of development.	IFIs have important standards that seek to make the procurement process as transparent and non-discriminatory as possible. Bidders must also prove certain eligibility criteria including demonstrating expertise and experience or a certain degree of financial health, to show they are able to fulfill the safeguards set by the lenders' policies. Reconciling these requirements was challenging in the case of CSP power tower technology, because it is at an early stage of deployment and there are only a limited number of experienced technology and service providers. Given the risks associated with the early technology development cycle, Eskom and the lenders have agreed to discussions with prospective bidders (the OE or EPC contractors in Eskom CSP) to ensure that risks are adequately addressed in the structuring of the project and that the most suitable, experienced and cost competitive provider is awarded the contract.
Administration context. Large projects with many involved IFIs would benefit from a harmonized approach to procedures and standards.	The lack of harmonization among IFI lenders, and differences between public spending policies and lender requirements, are issues that merit further consideration by IFIs, especially in the context of climate finance when delays can result in cost escalation and jeopardize project viability.
Finance context. Project sponsors and lenders need to investigate what foreign exchange rate risks exist and respond to them accordingly.	While foreign public debt offers lower interest rates (less than 2%) than South African lenders (around 12%), the cost for hedging the related foreign exchange rate risk, can increase the cost of debt by up to 8% at current rates depending on the currency and the degree of hedging employed. Eskom handles the sensitivity of project returns to currency exchange rates using in-house expertise in exchange rate hedging and accepts the decreased value of concessionality in the early loans.

Eskom CSP demonstrates that public support is still required to deliver on the global expectations of CSP

As long as CSP technology is still moving down its learning curve, it is clear that CSP projects need public support in its broadest context to finance plants and drive cost reductions. The technology is currently still at an early stage, thus presents many development uncertainties and challenges to its investors. Proof of technical design and related system performance will help to establish the real value of the technology in particular large volumes of storage, and incentivize its replication and scale up. It will also help to reduce risk perception among all stakeholders including project developers, host governments and possible future lenders. National policymakers and international funding can cover risks that commercial stakeholders are unable or unwilling to take, thereby mobilize private investments in CSP, accelerate efforts to scale-up CSP and reduce its costs.

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1. Introduction

Among renewable energy technologies, concentrated solar power (CSP) is of particular interest because its ability to store solar energy as heat allows the delivery of power even after the sun sets. This mechanism can help overcome gaps from balancing supply and demand, including those arising from other renewable energy sources, and helps to maintain a stable yet low-carbon energy supply. CSP holds particular promise for emerging economies like South Africa that have abundant solar resources, a need for reliable baseload energy, and a growing demand for peak load provision.

However, CSP investment and production costs are high compared to other more established conventional options such as fossil fuel generation and renewable energy technologies. Although CSP technology has been deployed to small degrees for some time, there is still large potential for bringing down the technology learning curve and reducing costs and risks associated with the technology. For now, CSP projects still require public interventions to be financially viable.

Investing in CSP involves significant risks and challenges, both for project developers and the public sector. Private developers, on one side, have to consider potential technology failure, regulatory change, the sensitivity of project economics to debt costs and exchange rates. The public sector, on the other hand, faces the twin challenges of keeping costs to the public low and finding the right tools for encouraging private investment in CSP deployment.

The Climate Investment Funds, one of the major public institutions supporting CSP, has commissioned CPI to undertake the study '*The Role of Public Finance in CSP*', to distil lessons on the effectiveness of different public financing approaches to promote CSP deployment and future scale-up. The background paper published as the first in CPI's series on CSP (Stadelmann et al. 2014a) identified key questions on the effectiveness of public finance in enabling CSP:

- Is public support needed in all cases? If not, in which cases is it needed?
- How effective or cost-effective are different policy and public investment tools?
- Can public policy and support drive technology cost reductions simply by enabling additional capacity, or are more specific interventions needed?
- How can international public finance best support national policy efforts in emerging economies?

To answer these questions, the project '*The Role of Public Finance in CSP*' examined two case studies,[1] one market brief, and a policy paper distilling the lessons. Three stakeholder dialogues will provide input into these paper's findings.

In this case study, we analyze the financing, risk arrangements and national policy context for establishing the Eskom Concentrated Solar Power (CSP) plant in Upington, South Africa. **Despite developing early project designs over 10 years ago, Eskom CSP remains the most ambitious and technically challenging CSP power tower[2] project under development anywhere outside of the US with respect to its technology choice, capacity and storage**. In supporting this project public funders realize a number of objectives: 1) enabling South Africa to diversify away from coal and 2) support the deployment of CSP power tower technology, often identified as the technology with the most potential for cost reduction and local content in CSP (ESMAP 2013, Fichtner 2010).

Section 2 provides an overview of the national context in which the Eskom CSP project is developed and examines the project timeline and the main stakeholders who made the project possible. **Section 3** considers the economic inputs and outputs of the project as a whole. **Section 4** considers the risk management framework, including risk allocation of the various technical, economic and financial risks associated with the project. **Section 5** explores the effectiveness of the project in the short- and long-term, compares it with other CSP projects in the country, discusses the replication and scale-up potential of the project's financing structure and likely routes to unblocking such potential. Section 6 reviews the study's findings and offers suggestions for further research.

1 This case study of Eskom CSP and one on the Rajasthan Sun Technique plant in India. See this link for more: http://climatepolicyinitiative.org/publication/san-giorgio-group-case-study-the-role-of-public-finance-in-csp-india-rajasthan-sun-technique/

2 CSP power towers – also called central receiver - consist of a series of large mirrors typically placed in concentric circles around a tower in the center. Each mirror has a separate motion system which positions the mirrors so that the reflected solar beam focus on a point located at the top of a tower which super heats a fluid or heat transfer medium. This medium, in some cases molten-salt, turns water to steam to drive a turbine and generate electricity. Some of the heated medium can be stored for production of energy later, or cooled and returned into the cycle.

2. Project and Policy Context

- In order to increase energy security and meet emissions reduction targets, South Africa aims to add 20 GW of new renewable power generation capacity by 2030, of which 3.3 GW could be from CSP.
- Eskom CSP is an ambitious and technically challenging CSP power tower project under development in South Africa planning to install the largest power tower (100MW) outside of the US and the third largest storage capacity (9-12 hours) in the world.
- A key aim of this project's technological configuration has been to help develop a real and scaleable alternative to baseload coal fired power, bring CSP power tower technology costs down and share the lessons learned for the benefit of future plants.

2.1 CSP in South Africa

The transformation of South Africa's energy sector is key for achieving the country's climate targets. The GoSA conditionally[1] committed to reduce greenhouse gas (GHG) emissions by 34% below business-as-usual projections by 2020, and by 44% by 2025 (GoSA, 2009). The energy sector plays an important role in how the country achieves these targets. While fossil fuel power generation currently provides over 90% of the electricity (EIA, 2014), South Africa is seeking to reduce its reliance on carbon-intensive coal-based energy (AfDB, 2010a).

Renewable energy including CSP technology can also help to tackle South Africa's energy security concerns, given that public support helps to address investment risks. CSP technology in combination with large volumes of storage[2] offers a real and scaleable alternative to baseload coal fired power, can offset expensive oil and diesel-based peaking plants during peaks in power demand (BNEF, 2013) and contribute to network stability. High cost is a major obstacle to CSP development in South Africa, especially because the country's urgent need for large volumes of additional power generation capacity[3] favors carbon-intensive coal power. This is because South Africa has access to large volumes of cheap local sources of coal, and benefits from a long-track record in the technology. As has been the case in almost all CSP projects to date (Stadelmann et al. 2014), public support is still required to unlock CSP investment in South Africa because alternatives, such as coal, have fewer investment risks.

By deploying CSP technology, South Africa can also foster a renewable energy industry and help meet social and economic development goals. Energy and electricity more specifically plays a key role in the pulling South Africa out of poverty. The country faces significant social, economic, and environmental challenges, and its national development is a central action item for the government, including increasing the level of content provided locally (GoSA, 2011). CSP technology offers the country these broadly based green economy benefits by creating jobs and fostering the development of local supply chains (ESMAP 2013).

The Government of South Africa (GoSA) developed policies to transition to a clean and sustainable energy system, in which CSP can play an important role. South Africa has one of the lowest penetration levels of renewable energy in major economies sourcing only around 1% of primary energy consumption from renewable energy, almost all of it hydropower (IRENA 2014, EIA 2014).

1 President Jacob Zuma announced the commitments at the 2009 conference of the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen. The target became one of the most ambitious announcements of the non-Annex I nations. The commitment is conditional on a global climate agreement and South Africa receiving financial, technological and capacity building support from developed countries.

2 The storage element of CSP means it can provide firm yet flexible production of energy, while also tapping renewable sources of energy: see, e.g. IEA, 2010.

3 South Africa's rapid economic growth since the end of Apartheid (World Bank, 2014) is demanding an ever increasing supply of stable power for its industry. At the same time, the government is also committed to meet important social development objectives such as bringing the energy network to all areas and communities of the country (DoE, 2013).

Box 1: South Africa's demand for energy rapidly increased beyond capacity in the early 2000s.

With abundant, cheap and locally sourced coal reserves, South Africa has for years benefited from low-cost energy as a result of a massive coal fired power generation capacity addition program in the 1970/80s. Until the mid-1990s, the country had access to almost twice the power generation capacity it needed (operating with a capacity reserve margin close to 50%) and could even mothball or close unneeded power plants.

This situation of excess capacity changed with strong industrial and economic growth[1] and a successful domestic electrification program, which increased electricity demand by 60% from 1994 to 2006 (CIF 2009). At the same time, no new generation was connected to the network in the period 2001 to 2006, placing pressure on the existing generation fleet. In 2003, South Africa's state-owned electricity utility, Eskom, warned of possible future energy shortages and difficulties in meeting peak demand by 2007, and that these shortages would affect baseload demand in 2010. In the period 1994 to 2008, the reserve margin fell from 25% to 8% (AfDB, 2009), compared to an international standard estimated around 15% to 25% (GoSA 2009).

Almost inevitably a major energy crisis occurred in late 2007/early 2008,[2] triggering decisions by policymakers to reevaluate sector investment needs and the role that Eskom would play as the state-owned energy utility. In a major build program, Eskom hoped to invest some USD 45 billion over a five year period to 2013, aiming to increase generation capacity by 12.5%. Around the same time, the government and NERSA (National Energy Regulator of South Africa) discussed the potential for opening power generation to independent power producers (IPPs). Facing further funding shortages as a result of the recession and immediate energy security concerns, Eskom placed a number of planned renewable energy projects on hold in 2009, including Eskom CSP.

1 Annual growth in Gross Domestic Product (GDP) between 2000 to 2008 (before the economic crisis in 2009) was approximately 4% per year (World Bank, 2013). The AfDB expect GDP to continue to grow at 4% per annum in the medium- to long-term, requiring the addition of 1500 MW of new capacity each year (or an additional 3-5% of current generation capacity each year). (AfDB, 2010b).

2 Energy shortages resulted in power rationing (including nationwide rolling load shedding, i.e. blackouts) to prevent the electricity system collapsing, and ultimately impacted the whole economy. The country's mining industry, a main user of energy and major contributor to the national economy, faced shutdowns for days. Coincidentally, the economic slowdown during this period and electricity disruptions reduced GDP growth to the lowest in more than six years (AfDB, 2009).

This is despite excellent renewable energy resources (SANEDI, 2013), including some of the world's best solar resources.[4] In order to exploit these resources, South Africa has adopted an ambitious clean energy build-out plan: to add 20 GW of new renewable power generation capacity by 2030 (almost 50% of current generation capacity), of which 3.3 GW is expected to be from Concentrated Solar Power (CSP)[5] – approximately equal to the current installed capacity of CSP worldwide (Stadelmann et al., 2014a). In 2011, South Africa's Department of Energy introduced the Renewable Energy Independent Power Producers' Procurement Programme (REIPPPP). The design of REIPPP is intended to improve energy security and economic development, and encourage low-carbon energy by incentivising private investment through revenue support incentives and introduce competition into the power generation market. As part of this program, 400 MW of CSP capacity is in the process of being procured. See Annex 1 for further policies that were important to the development of CSP in South Africa.

4 In Upington, the long-term solar resource average is estimated to be substantially higher than both Spain and the US, currently the two leading markets for CSP deployment. A study used satellite and ground measurements taken from 1994 to 2010 to estimate a Direct Normal Irradiance (DNI) of 2816 kWh/m2 (energy per area) (GeoSolar, 2011). DNI is a measure of the volume of solar energy per square meter of ground. For reference, Spanish DNI is approximately 2000-2200 kWh/m2, while some US-based CSP plants reach 2700 kWh/m2 (GeoSolar, 2011). Given the potential solar resource, the Upington region is the center of CSP development in the country. South Africa's national electricity utility, Eskom, suggests that some 40 GW of CSP could be developed there, with a further 20 GW in neighboring Botswana and Namibia (AfDB, 2010a).

5 Technology options arising from IRP 2010 (DoE, 2019)/ IRP 2010 Update (DoE, 2013).

2.2 Eskom CSP Project

As the state-owned electricity utility and most important energy sector actor, Eskom plays a key role in fulfilling the government's goals for a low-carbon energy supply, and socio-economic development. For the 100MW Eskom CSP project near Upington in the Northern Cape region of the country,[6] the company chose CSP power tower technology because of its potential for building up local supply chains and for efficient storage capacity. Storage capacity offers an alternative to peak-load power supply which is currently provided by expensive imported oil or gas, while the selected generation capacity is expected to provide a higher cost reduction potential than smaller installations (Fichtner, 2010). The project is expected to produce around 500 GWh of clean energy per year[7] to supply up to 200,000 homes[8] and offset 450,000 tonnes of CO2 (equivalent) (CIF 2013). Because Eskom CSP delivers a capacity factor of 60% or more, it can compete even with the most efficient gas power plants (which average around 45-65% capacity factor accounting for generation efficiencies while wind and solar photovoltaic capacity factors are significantly lower).

Eskom CSP is one of the most ambitious and technically challenging CSP power tower projects under development outside of the US with respect to its technology configuration. Eskom CSP's innovation lies in its technology configuration: 100 MW in generation capacity, using a dry-cooled steam cycle, and 9-12 hours of molten-salt storage.[9] Only 500 MW of CSP power tower projects are currently installed and commissioned worldwide, with only 100 MW outside of US spread across 12 relatively small projects (BNEF, 2014). In this case study, we evaluate the project as it is planned not questioning the configuration chosen, but rather consider its potential benefits if successfully implemented.

6 The Olyvenhouts Drift Site is located approximately 20 km west of Upington on land acquired by Eskom, and near the Oranje River, from which water will be sourced.

7 In addition, to fill the large amount of storage, the plant will need to convert a greater volume of solar energy into thermal energy compared with the generating turbine unit. This is called the 'solar multiple' of a CSP plant: that is, the comparison between the potential power output from solar mirror versus the power of the generating turbine. Eskom CSP is expected to have a solar multiple of around 2.5, meaning the mirrors can generate enough power from the sun around 2.5 times the power rating of the generation turbine. The difference is energy that is transferred into heating the storage medium.

8 Assuming an average monthly electricity usage of 200 kWh per household.

9 The exact quantity of storage is yet to be finalized at the time of writing, but is expected to be 9-12 hours.

If commissioned, Eskom CSP will be the largest project outside of the US. In addition, its storage capacity will be the third largest in the world. Hence, the project could deliver substantial global learning and benefits that could lead to replication of the project and scaling up of CSP.

2.3 Project timeline

The Eskom CSP project was originally planned to be the first major installation of CSP in South Africa. Towards the end of 1990s, Eskom carried out studies on the feasibility of CSP in South Africa.[10] Later the company commissioned resource mappings to identify suitable regions, in addition to determining which CSP technologies fit best with the country in terms of operation and identifying critical components and local content. Early designs of Eskom CSP were discussed in 2003: a large CSP power tower project with a substantial amount of storage. In 2006/07, Eskom received environmental approval for such a project. With a four-year design and construction process, the project could have been commissioned in 2010/2011. After several years in development Eskom CSP was placed on hold in 2009, largely because of the global recession and pressure to alleviate energy security concerns, which resulted in a reassessment of investment priorities.

Support from international financial institutions (IFIs) allowed the project to proceed after Eskom placed it on hold in 2009. With the support from IFIs, the Government of South Africa developed the USD 500 million Clean Technology Fund (CTF) Investment Plan for South Africa in 2009 (GoSA/CIF, 2013). The investment plan allocated Eskom CSP USD 250 million. A 2010 study (Fichtner, 2010) revised and updated project estimates related to the appropriateness of tower technology with several hours of storage for Eskom CSP, including estimates of costs. The relevance of this study was revisited and confirmed in 2012. In the same year, Eskom contracted an Owner's Engineer (OE – an engineering design consortium) to optimize the project concept and basic designs and increase confidence on costs and feasibility. A further study in 2012 verified Eskom's choice of technology and put lenders at ease with their decision. The choice of technology by Eskom demonstrates that they owned responsibility of the project process, aligning with the World Bank's expectation that projects should be country led. In parallel, Eskom gained additional funding and funding approval

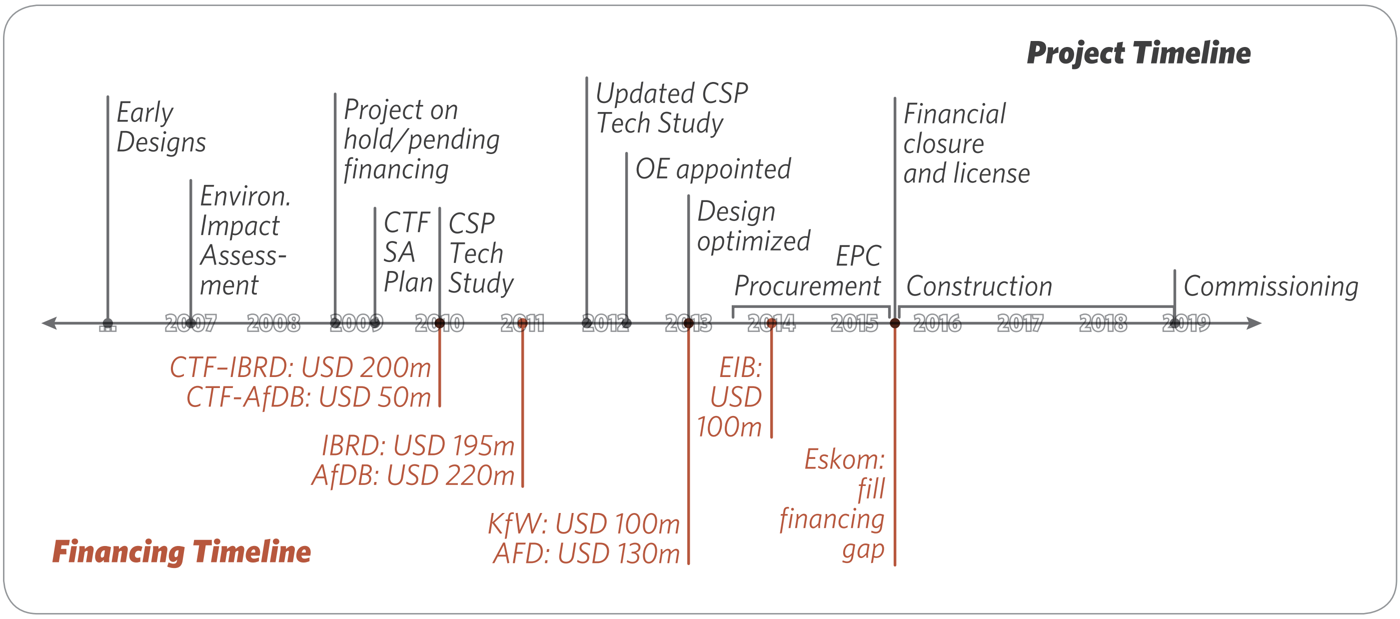
10 In 1998, Eskom worked with US National Renewable Energy Laboratory (NREL), receiving funding from GEF (Global Environment Facility), to screen suitable technology and develop a feasibility study for CSP in South Africa.

from five other IFIs, which put the project back on track (see Figure 1 for financing timeline).

Construction will commence towards early-2016, and is expected to take three years to complete. The optimized design for Eskom CSP was completed in 2013, and towards the end of the year, Eskom commenced the two stage procurement process to acquire an Engineering Procurement Construction (EPC) contractor by 2015. It is anticipated that the EPC will take the plant from optimized design to commissioning and provide five years of operation and maintenance.

The Eskom CSP timeline shows the main project milestones, from early studies in 2003 to expected commissioning in 2019.

Figure 1: Key project and financing milestones for Eskom CSP



Sources: CPI, publically available sources

3. Project Overview of Eskom CSP

- Low-cost debt lending from international financial institutions and balance sheet finance from Eskom allowed the Eskom CSP project to proceed.
- A key aim for this project was to help bring CSP power tower technology costs down and share the lessons learned for the benefit of future plants.
- The lack of deployment of CSP power tower with storage means that currently the CSP technology configuration chosen for Eskom CSP costs more than alternative options including conventional and renewable energy sources.

This chapter introduces financial inputs and outputs for each stakeholder involved in the Eskom CSP project. While full financing details are unavailable, and the procurement for technology is still underway, we derive details on investment to the extent possible using information about project specifics if it is publically available, or industry standard assumptions if it is not.

3.1 Project stakeholders and their inputs

Both the developer and financiers for this large and complex CSP project are from the public sector. The project will be financed with public lending on a concessional basis from international financial institutions (IFIs), supplemented by contributions from Eskom. Private actors will not contribute financially to the project but will contribute technology design advisory services, and engage in project construction, operation, and maintenance. While it is not unusual for CSP projects to have large public contributions (given the high costs and technology risks - see Stadelmann et al., 2014), the fact that 100% of the financing for Eskom CSP is public is important to consider when analyzing the project. In this respect, Eskom CSP differs from all other CSP projects in the country.

The Eskom CSP financing plan has been firmed up since 2010 and estimates the financing requirement to be around USD 1 billion for a 100 MW CSP power plant with less storage than Eskom CSP (GOSA/CIF 2013). Initially, a technology study in 2010 estimated the project cost at approximately USD 780 million. The extended project development time, largely due to procurement challenges and policy requirements (see Section 5), and the recent volatility in the local currency could have had a negative impact on the costs.[1] Cost estimates will be final once the procurement for engineering and technology is finished.

- **Debt investor inputs: Eskom CSP will receive USD 995 million in highly subsidized debt[2] from six IFIs, which allow the project to proceed while lowering the financing costs**. Eskom increased lending from public sources by 30% over the development of the project to meet updated cost estimates (see figure 1 for the financing timeline and figure 2 for the breakdown of planned versus current estimates). The CTF Investment Plan for South Africa allocated Eskom CSP USD 250 million (USD 200 million via the World Bank (WB), and USD 50 million via the African Development Bank (AfDB)). Eskom secured an additional USD 195 million from the IBRD[3] Eskom Investment Support Project and USD 220 million from the AfDB.[4] In parallel, Eskom gained additional funding approval from European development finance institutions: USD 100 million from KfW,

1 However, the suppliers of this technology have had more time to optimize their cost structures as they have become more familiar with the operating regimes of their technology.

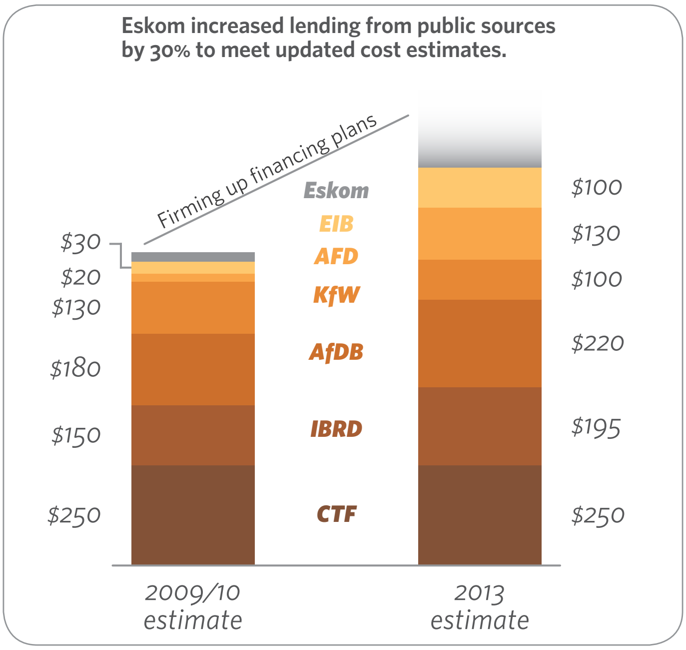
2 By subsidized terms, we mean that public capital is lent at more favorable than standard terms and interest rates of public finance institutions.

3 The International Bank for Reconstruction and Development (IBRD) is one of the five international financial institutions that compose the World Bank Group.

4 The WB/IBRD USD 195 million loan for Eskom CSP is included in the larger Eskom Investment Support Project (EISP), a USD 3.75 billion loan package supporting Eskom's 4.8 GW Medupi Coal Station, the Sere Windfarm and Eskom CSP projects, and improving the energy efficiency of Eskom's coal transportation. The AfDB also provides around USD 2.6 billion to the Medupi Coal Station. While controversial at the time, the objective of the EISP according to the WB was to help the Government of South Africa to assist the financing "the first two utility-scale renewable energy power projects and a large power plant [Medupi] that had already begun construction to meet the urgent power demand" (WB/IBRD, 2012).

- USD 130 million from AFD, and USD 100 million from European Investment Bank (EIB) in 2014.[5]
- **Equity investor inputs: By developing the Eskom CSP project 'on balance sheet', Eskom can reduce the cost of financing and cover substantial risks. While low-cost foreign debt makes up most of the total project cost, Eskom will cover any potential financing gap by contributing equity**. Eskom CSP is being developed by the state-owned national energy utility Eskom, a vertically-integrated energy utility representing more than 95% of the country's energy generation, transmission/distribution, and sales to customers. Eskom has many years' experience developing large and capital-extensive energy projects. By developing the project 'on balance sheet', the capital investment will be included in the company's asset base, on which Eskom earns regulated returns as granted by the regulator (see Box 3 for more discussion on how Eskom generates returns from the project). Moreover, Eskom is required to submit an internal 'business case' and get approval from the board, before bringing financial closure to the project. By developing the Eskom CSP project 'on balance sheet', Eskom can reduce the cost of financing and cover substantial risks.

Figure 2: Project cost evolution from 2010 estimates to current revisions



Source: GoSA/CIF, 2013; EIB, 2014.
Note: All co-financing approved except EIB, which is scheduled for mid-2014. In the case of AFD and EIB the amounts are USD equivalents.

There are other important actors in the development of Eskom CSP. Table 1 describes all actors and their financing roles for the project.

5 German and French development banks – Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute), and Agence Française de Développement (French Development Agency) respectively. For the purposes of our study, we use USD amounts for lending. AFD provided EUR 100 million, which we use in the report as USD 130 million. At the time of writing, the EIB contribution was announced to be EUR 50-75 million, but not officially approved, or USD 100 million in the report (EIB, 2014).

Table 1: Eskom CSP stakeholder descriptions and financing roles.

STAKEHOLDER	DESCRIPTION AND ROLE	ESKOM CSP FINANCING ROLE	
Publicly-owned project developer	Eskom Holdings Ltd	• State-owned vertically-integrated utility established: generates, transmits, distributes and retails electricity to consumers. • Regulated entity subject to pricing controls under NERSA. • generates more than 95% of the South Africa's electricity, more than 90% of which is fossil fuel based; generates ~ 45% of the electricity used in Africa; one of the top 20 utilities in the world, with over 42 GW of installed capacity. • Recently formed Single Buyer Office carries out contractual Power Purchase Agreements with IPPs in the national Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).	Balance sheet equity, if needed to fill the gap between project cost and total public debt.
National government and public bodies	Ministry of Public Enterprises	• Government shareholder representative with responsibility for South Africa's state-owned companies across the economy: monitors performance of these companies, including investment, operations, and compliance. • Sole shareholder of Eskom Holdings.	Approval of Eskom investment, subject to the PFM Act. [1]
	NERSA	• National Energy Regulator of South Africa: regulates and enforces laws pertaining to the energy sector and grants generation licenses. • Protects consumer affordability first, then ensures South Africa takes advantage of natural resources accounting for environmental targets. • Promotes private sector participation by encouraging investments from IPPs, and off-grid technologies for rural development. • Determines control of electricity tariffs charged by Eskom in control periods.	Regulate and approve any returns from Eskom's Regulated Asset Base.
	Ministry of Environmental Affairs	• Develops Strategic Environmental Assessments, authorizes and approves EIAs, determines water allocations.	Representative ministry for CTF lending.
	National Treasury	• Manages state funds: Coordinates development bank and AfDB financing with the Government of South Africa (GoSA) and provides guarantees to public lenders their behalf. • Represents GoSA in World Bank and AfDB as both donor and user of funding. • Determine procurement rules for Government and state-owned enterprise.	Approval of Eskom exemption from national procurement Act. [2]

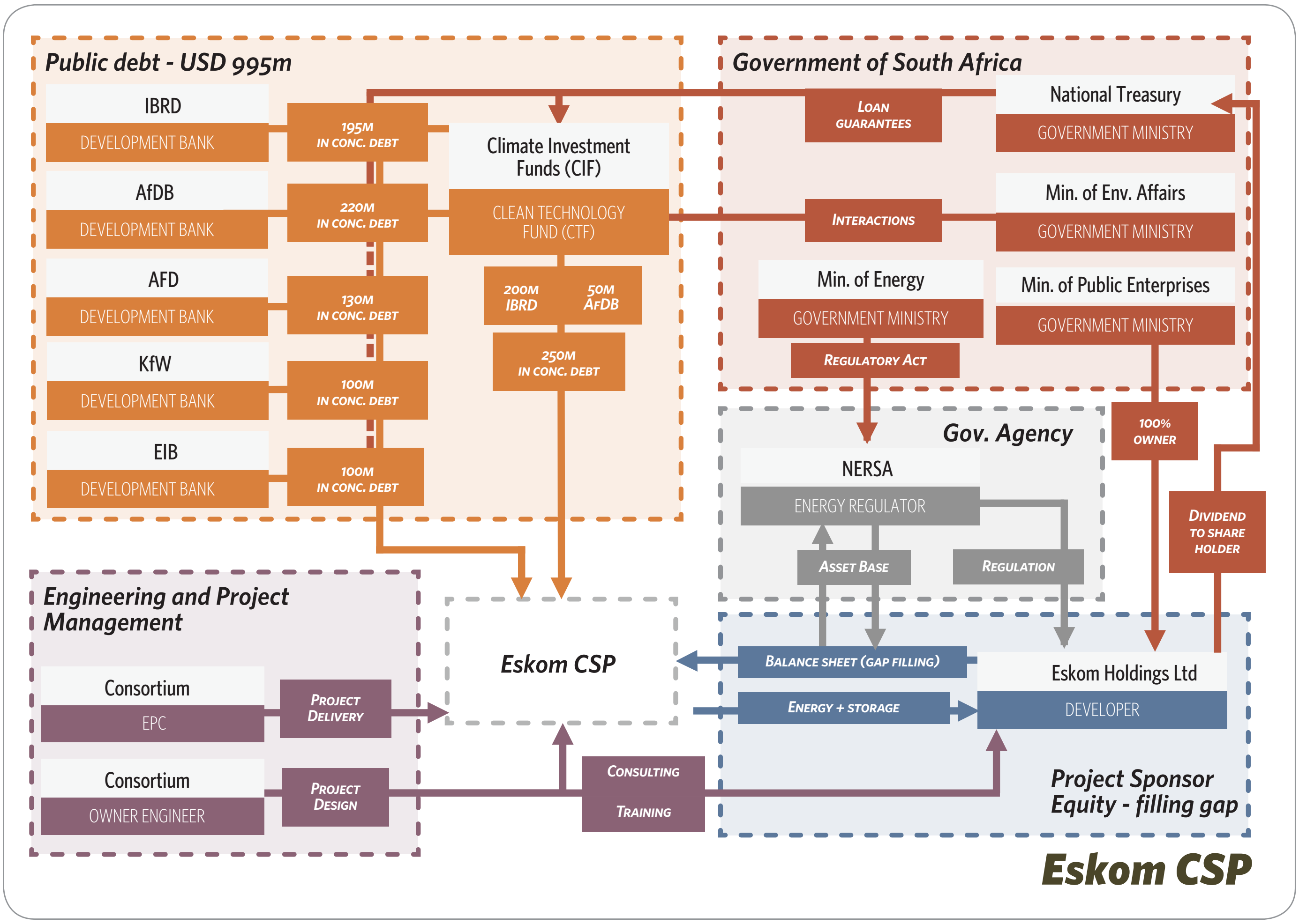
1 Public Finance Management Act of 2012. To ensure the effective management of public finances by the national and county governments, including state-owned entities.

2 Preferential Procurement Policy Framework Act of 2000. Mandates that procurement of services and technology within state representatives (including Eskom as state-owned entity) should work to support historically disadvantages individuals in fair, transparent, cost effective and competitive ways.

STAKEHOLDER	DESCRIPTION AND ROLE	ESKOM CSP FINANCING ROLE	
International Finance Institutions	Clean Investment Funds (CIF)	• Multilateral climate fund: provides approximately USD 8 billion to 48 countries. • Includes the USD 5.5 billion Clean Technology Fund: 60% of South Africa's USD 500 million CTF financing is allocated to CSP incl. 42 million to CSP projects in the private IPP process.	USD 250 million concessional financing (USD 200 million from WB, USD 50 million from AfDB).
	International Bank for Reconstruction and Development (IBRD)	• International finance institution and active lender in most middle income countries.	USD 195 million concessional financing.
	African Development Bank (AfDB)	• African Development Bank: established to contribute to the economic and social development of Africa. • Major supporter of infrastructure projects including energy projects.	USD 220 million concessional financing.
	Kreditanstalt für Wiederaufbau (KfW)	• German development bank: active both nationally and in bilateral cooperation with developing countries.	USD 100 million loan
	Agence Francaise du Développement (AFD)	• French development bank: renewable energy portfolio throughout Africa and other emerging regions. • Supports Eskom's wind energy project and other small renewable energy projects through local finance institutions.	EUR 100 million (USD 130 million equivalent) loan
	European Investment Bank (EIB)	• Development bank of the European Union: newly active in investments outside of Europe for generating long-term private sector growth, and supporting public sector development.	EUR 75 million (USD 100 million equivalent) loan (expected 2014).
Engineering and Project Management	Tractebel Engineering (GDF-Suez)	• Leads a consortium to carry out Owner's Engineer responsibilities including optimizing the initial concept design and assisting project development through to construction; project price discovery, identification and management of risks, reducing development uncertainties; training Eskom staff.	No financing, but important part of project development.
	Company or consortium to be determined	• Expected to receive a contract to carry out fully-wrapped EPC services in 2015: working with Optimized Project Designs to procure required technology, construct, manage risks, and commission the project. • Following commissioning in 2019, the EPC contractor will be expected to carry out full operation and maintenance of the project for the first five years. • Training Eskom staff for handover.	No financing, but important part of project development.

* With support from IFIs, the Government of South Africa developed the USD 500 million CTF Investment Plan for South Africa: including allocating USD 250 million for the Eskom CSP project.

Figure 3: Mapping Eskom CSP stakeholders and their contributions the project



Note: loan guarantee details for lenders beyond World Bank, AfDB, CTF are unavailable due to confidentiality reasons.

3.2 Project outputs – Eskom perspective

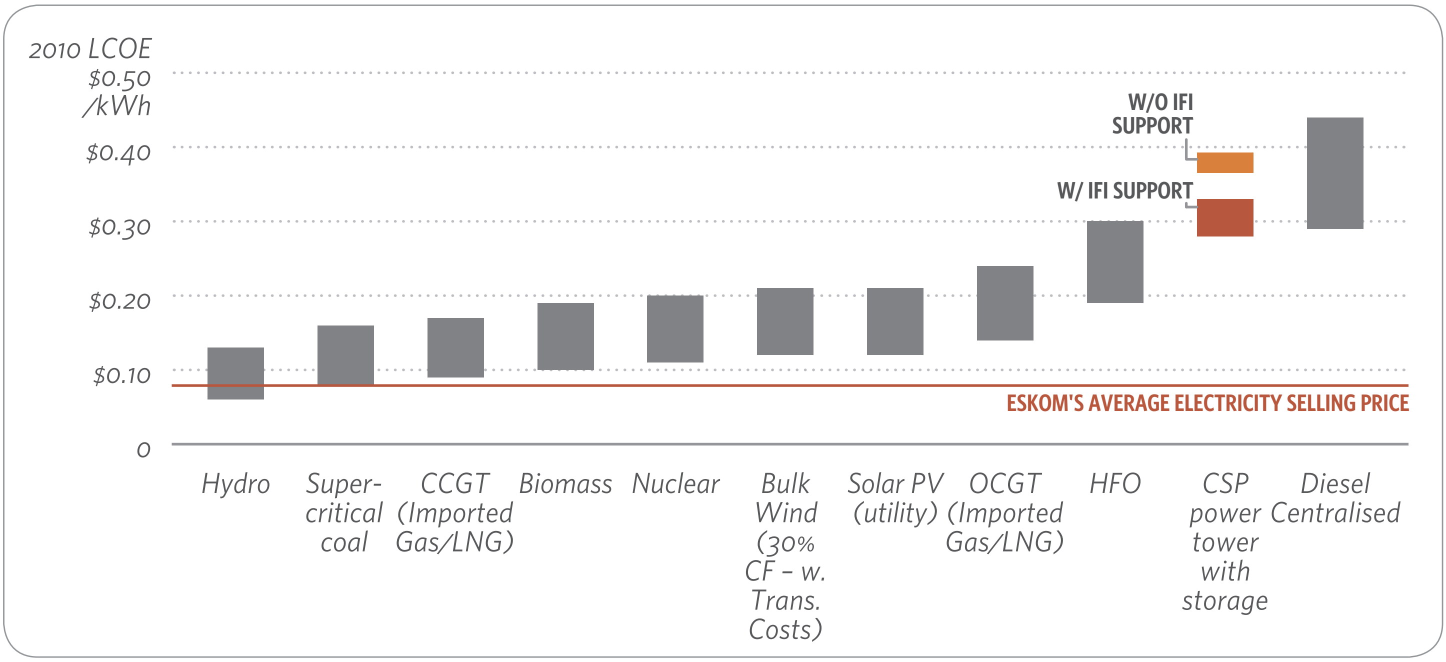
Eskom can charge customers an average 0.08 USD/kWh in 2013/2014 (Multi Year Price Determination (MYPD) 3). Because Eskom is subject to regulatory control and public spending laws, the company must ensure any large capital expenditures fit within allowed investment plans. From 2013 to 2018, the National Energy Regulator of South Africa (NERSA) has approved tariff increases of 8% per annum to generate revenues for Eskom's capital expenditure for new build plants, operating and maintenance costs (including primary energy) for its existing power plants, and purchase agreements from independent power producers (IPPs).

Estimates of levelized cost of electricity from CSP in South Africa (0.28-0.33 USD/kWh) confirm that CSP will be more expensive than other fossil and renewable options. As is to be expected for a cutting edge technology like CSP, the electricity comes at a higher cost. Figure 4 compares the levelized cost of electricity in South Africa for CSP (0.28-0.33 USD/kWh) to hydro (0.06-0.13 USD/kWh), new coal (0.08-0.16 USD/kWh), and open cycle gas turbines (0.14-0.24 USD/kWh) (IRENA, 2014b).

While low-cost debt provided by IFIs can lower Eskom CSP electricity production costs by 0.03-0.11 USD/kWh, the technology remains one of the most expensive in Southern Africa's energy mix.

Table 2 illustrates that the cost to Eskom could exceed the financial outputs from Eskom CSP. However, the Eskom CSP project is the first of its kind in Eskom's energy portfolio. As a result, it does not have the same financial investment criteria as Eskom's other investments. Instead, it offers good potential for non-financial benefits such as creating jobs, offsetting 500 GWh of coal-fired power generation each year, promoting technology cost reduction, improving South Africa's energy security and contributing to energy system stability through efficient operation.[6]

Figure 4: Cost of electricity from Eskom CSP plant as compared to other technologies and Eskom's average electricity selling price



Source: CPI calculation, IRENA 2014b
Note: This comparison does not reflect any shadow price of carbon.

6 See Section 5 for further discussion of Eskom CSP non-financial benefits.

Box 3: Earning returns from the regulated asset base

By financing on balance sheet, the Eskom CSP asset will form part of Eskom's asset base (the value of its balance sheet). The regulated return which Eskom earns on this asset base is part of the tariff methodology that NERSA applies during the relevant pricing period.[1] In this process, Eskom raises investment funds by increasing the tariff charged to electricity users, but its investment is restricted ('regulated') given its operational obligations.

Since the Eskom CSP project is small relative to the Eskom's total asset base, its impact is spread across the existing asset base (comprised mainly of cheap, largely depreciated coal assets). While we did not calculate the full impact, the provision of concessional finance to Eskom CSP, Sere Windfarm and to the large Medupi coal power station should have reduced the impact of these combined projects on the utility's overall return on assets,[2] at least compared with other more traditional financing methods.

External equity and commercial bank debt, while available, are expensive and cannot be easily matched with Eskom's existing funding structure.[3] Concessional lending from DFIs, however, forms an integral part of Eskom's funding strategy. Thus, as project cost estimates firmed up, Eskom obtained more low-cost debt from IFIs, while remaining prepared to fill any financing gap with more equity to close the financing of the project.

As a result of not being financed as an individual project, Eskom CSP will not generate cash flow as a standalone asset. However, since our analytical goal is simply to show the relative importance of various financial flows and values to the project, we model it as if it were an independent entity.[4]

Table 2 summarizes the key energy and financial outputs for the Eskom CSP project.

1 Price control reviews have evolved to protect consumers from sudden increases in tariffs, and incentivize effective investment from Eskom. In the 1980s to mid-2000s, increases in electricity tariffs were consistently below inflation (Eskom, 2014), meaning electricity prices effectively declined. However, rapidly reducing generation margins increased pressure on electricity tariffs and investment needs, triggering a controlled approach. Currently, Eskom are in the third price control period for five years 2013 to 2018. The first control period ran 2006 to 2009, and second 2010 to 2013.

2 While we did not calculate the impact, however, we strongly expect Eskom can justify the added cost of Eskom CSP because they received substantial concessional financing for the large Medupi coal-fired power plant. See footnote 4 on page 6 for further details.

3 Additionally, while the five commercial banks show interest in South Africa's private renewable energy investment program including in other CSP projects, they still do not show appetite for large and innovative CSP tower projects such as Eskom CSP. As a result, the other tower project, a 50 MW with 2 hours of storage by Spanish CSP world leader, Abengoa Solar, is financed with private and public sources of equity and only public sources of debt. See Section 5 on other South African CSP projects.

4 In any case, calculating returns on asset bases is subject to many assumptions that can distort the real outcome such as: existing capital and operational assets, new capital additions, operational expenses, depreciation of existing assets, retirement of old asset, existing debt structures and repayment schedules, or new bond equity issuances.

Table 2: Eskom CSP project output and cost analysis

ESKOM CSP PROJECT RETURN BREAKDOWN	ESKOM CSP VALUE	COMMENT
Annual energy generation	470-525 GWh	The Eskom CSP is expected to generate its maximum rated energy output for 25 years.
Value of electricity	USD 73.5 million/ year	Based on an estimated "willingness to pay" of USD 175/MWh, (figures from World Bank, 2011). This figure is based on survey data on what customers thought clean power from CSP is worth, including environmental and other benefits. Since CSP with storage can be dispatched when prices are high, at least some of the electricity generated from Eskom CSP will offset costs near the top of that range - the peakload price can rise over USD 220/MWh, while the baseload price can be as low as USD 30/MWh. Thus, this "willingness to pay" may not be far off from the economic value of the electricity, even excluding environmental benefits. This will depend on how South Africa's power mix moving forward affects the load shape and thus the value of CSP's ability to generate electricity during off-peak times.
Value of electricity over project lifetime of 25 years	USD 654 million	The present value of annual generation worth 73.5 million (as described above) based on generation starting when commissioning the plant (in year 5 of the project) and discounted with a discount factor of 6.5% over the project lifetime (25 years).*
Operational savings	Not estimated	The system operator (Eskom) can dispatch Eskom CSP, meaning the energy output can be controlled and used as needed. This presents an efficiency gain for the system as a whole because it can be used in peak periods, and thus a cost saving. This is different versus other traditional renewable energy generation such as wind, or other non-Eskom CSP plants, that are not 'dispatchable' by the system operator and have an operating cost associated to them. While energy system benefits have not been estimated, Eskom CSP is expected to assist energy security of supply, contribute to meeting both base and peak demand, and offset coal energy use to avoid future coal cost and the proposed carbon price for energy-intensive industries.
ESKOM CSP PROJECT COSTS	**VALUE**	**COMMENT**
Costs to Eskom over project lifetime	USD 1,166 million*	Present value of costs to Eskom associated with the project including capital investment over the four/five-year construction period, operation and maintenance expenses, and interest payments on the loans.
Currency Hedging costs	USD 260-510 million	Estimated cost of hedging currency risk over the project lifetime, based on a 50-70% hedge ratio.
Early vintage costs, to Eskom and IFIs	Not estimated	The early entry by Eskom prepared the ground for future CSP developments in the country (e.g. studies on solar and water resources, land, system). Similarly, by funding Eskom CSP, the IFIs take on a degree of early vintage cost that will not be borne by future projects that benefit from learnings. See Section 5 for more information.
Levelized cost of energy (LCOE)	USD 0.28-0.33/kWh*	The Eskom CSP LCOE is high but in line with other CSP projects in development given the innovative nature of the project (Stadelmann et al., 2014a). The majority of costs are from capital costs (ca. 60%), operating costs constitute around 10%, and the remainder is made up of finance costs, including currency hedging. Currency risk increases project LCOE substantially. Without the need to hedge these risks, we estimate LCOE would be only USD 0.23/kWh.

* CPI financial model

Note: Project financial outputs are only illustrative as they cannot be calculated using typical project financing approaches, since the project will be 1) a demonstration project, and 2) included in the Eskom asset base/not considered as a separate entity. Where applicable, total revenues over the project lifetime are discounted at 6.5%.[1]

1 We use this rate to approximate Eskom's cost of debt (from bond yields). This is likely lower than their overall cost of capital, but higher than the cost of capital for this project.

4. Risk Allocation in Eskom CSP

- Eskom manages the most significant technology and engineering risks by contracting two parties with the ability and expertise to manage them.
- While enabling Eskom CSP, foreign debt from IFIs results in additional challenges, which Eskom had to manage. Addressing these challenges can lower costs and speed up implementation.

To ensure we capture all significant sources of project risk, we collected an exhaustive list of categorized risks that could affect the Eskom CSP project. Here, we first analyze and present the risk response for the three most important risks that if unaddressed would cause the project to fail, and then outline the final risk allocation implications for the major stakeholders.

4.1 Risk identification and assessment

To ensure we capture all significant sources of risk (non-material and low probability risks are excluded from the analysis), we categorize risk according to the three typical stages in project financing:

- **Development risks** cover project development all the risks incurred before the project begins to operate, including risks related to novelty of the technology during design, procurement, construction, and financing.
- **Operation risks** cover all the risks related to project output (reliability of output), operating and maintenance (O&M) costs, and revenues (delivery risks relative to the associated or expected benefits).
- **Outcome risks** cover the risks more specific to overarching public policy objectives and strategic investor objectives. They include the risk of not meeting renewable energy deployment and emissions reduction targets, inability to drive down the costs of CSP, inability to create local value through a national supply chain and related reputational risk.

Once we had categorized the risks, we systematically assessed them according to two criteria: their probability of occurrence / frequency (from very low to very high) and their impact on the project's financial and non-financial objectives (again from very low to very high):

Moderate-risk events

Risk events with moderate-probability of occurrence, but medium-high impacts:

- **Reliability of output**: Lower than expected resource levels (solar radiation) on a given site or adverse weather conditions (e.g. dust) or events (e.g. storms or droughts) would lead to variation in production. The developer typically mitigates this risk by including error margins in project output modelling, and signing reliability contracts with technology providers.

High-risk events

Risk events with high to very high impact whatever the probability of occurrence:

- **Lack of in-house CSP expertise**: Until the Sere Windfarm and Eskom CSP, Eskom's energy portfolio did not include non-hydro renewable energy sources. The novelty of Eskom CSP (large-scale CSP power tower and large volumes of storage) presented new challenges to the Eskom project development team and internal project management processes. CSP project preparation and market sounding for CSP has taken more time than for other more conventional projects (even than other renewable energy projects). Adapting company policies and procedures to the specifics of the new technology has proven to be a process that requires additional administrative management, extending the project timeline and increasing cost.
- **System performance risks**. The lack of operational history of CSP power tower projects with long storage capacity like Eskom CSP means there is a limited ability to accurately predict the supply of power or availability of storage to respond during peak-load power needs. In particular, failure to effectively use the thermal storage would reduce its output, potentially even rendering the plant unable to supply peak-load power. This in turn would seriously undermine the economics of the project (a risk the developer bears). Similarly, degrading performance over time due to the high stress environment (e.g. exceptionally dry conditions, heat and sun) could cause uncertainty and possibly higher costs. These impacts are typically mitigated to some extent with performance

and reliability contracts and warranties with technology suppliers.

- **Risk of not securing enough suitable capital**. As a regulated entity, accessing suitable capital is critical to Eskom's investment program. Ultimately, NERSA, the national energy regulator, determines the maximum returns that Eskom can recover by including Eskom CSP in their asset base. As a state-owned regulated entity, Eskom has access to a diverse set of financing sources. While financing Eskom CSP on their balance sheet allows Eskom to raise cheaper capital and internalize risks, it limits the options that Eskom has to access equity. In general, investors are less comfortable with large-scale CSP power tower as compared to other CSP technologies due to the limited history of operation at scale, particularly in emerging economies. They are hesitant to participate without guarantees, sponsors with strong balance sheets, or highly experienced EPC contractors; and if they do, may require a more conservative approach to financing terms: higher equity upfront, higher pricing of loans, or shorter tenor.[1]
- **Foreign exchange rate risk**. Foreign exchange rate risks can have a substantial impact on capital cost which can threaten the overall project by causing delays or limiting the ability to secure the required financing from additional lenders. The Eskom CSP project faces high foreign exchange rate risk because it owes debt in currencies other than the currency in which revenues are generated. The risk is particularly high given the volatility of the Rand as local currency compared to the major global currencies. Only once the procurement has taken place, and contracts are concluded, will Eskom be able to better estimate the actual impact of foreign exchange risk and hedge the foreign denominated cost.
- **Political approvals, guarantees and exemptions**. Applying and gaining political approvals (e.g. environmental, power generation licenses, investment by a public entity), guarantees (e.g. loan guarantees), exemptions (e.g. local content requirements) are a standard process in any capital intensive project. However, as a state-owned entity, Eskom needs to ensure any investment adheres to public spending policies. In the Eskom CSP case, some of these requirements together with lender requirements have contributed to the long development cycle, which lead to higher costs, and slower project development.

4.2 Risk analysis, allocation and response strategies

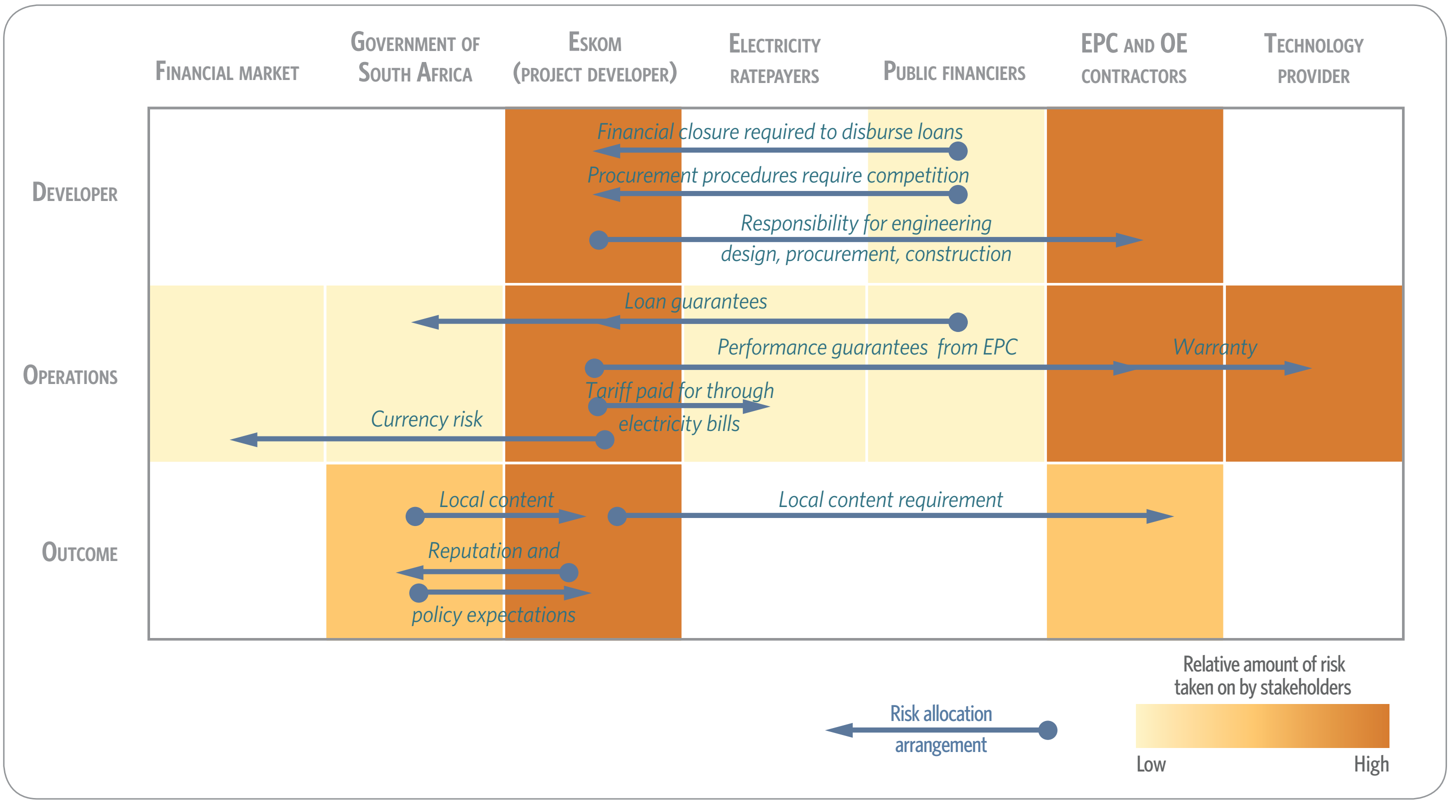
Eskom is obliged to avoid unplanned costs and eliminate risks carefully. Eskom CSP is being developed during a period of supply constraints where delivering a cost effective reliable supply of energy is of paramount importance for the South African economy. Eskom needs to ensure that capital expenditure, and operating and maintenance costs of their whole asset base can be paid by the revenues that the company creates from the regulated tariff charged to consumers.

The dynamic risk allocation matrix in Figure 5 illustrates the company's risk management strategy. It shows two aspects: risk allocation, which stakeholder bears risks at project initiation, and risk response, how the overall risk profile shifts through the use of risk allocation arrangements.

From the high-risk events identified earlier, we focus on the drivers and impacts of those that most threaten the project's viability, namely, technology risks and financing risks. There is evidence to suggest Eskom adopted a careful approach to risk management by allocating risks and uncertainties to those best placed to manage them, and internalizing any in which they have existing expertise or capacity.

1 Independent project developers also face this risk. In the current highly competitive environment (increasing bids, reduced tariffs, large (single) tickets of project funding) there is limited room for them to shop on financing terms or investors. The result is a situation that might lead to inability to get enough debt commitment to cover the large capital cost.

Figure 5: Eskom CSP dynamic risk matrix.



Note: Risk is categorized according to the estimated 'magnitude of risk' multiplied by the 'likelihood of risk': from 'very high' in dark red to 'high' in orange, 'moderate' in light orange, and 'low' in yellow. Given the lack of contract-level data available on this project, this weighting system is subjective. Numbers relate to risks as discussed in the text.

Lack of in-house CSP expertise

Eskom manages the most significant technology and engineering risks by contracting two parties during key milestones of the project. A move into CSP in the late 1990s presented unique challenges to Eskom, given its lack of experience with the technology and the little known even regarding the solar resource in South Africa.

Typically, Eskom would undertake all project aspects (design, commissioning and operation) in-house, and outsource only when the need arises such as for unique projects like Eskom CSP. In Eskom CSP, Eskom and lenders developed a procurement plan, which included outsourcing elements of the project development to

DESIGN	By contracting an Owner's Engineer (OE), a design engineering consortium to develop the basic design and implement it until commissioning, Eskom benefited from external expert advice on all aspects of the developing stage. Working with Eskom, the OE worked on basic design requirements, and eventually produced an Optimized Design which was a necessary element to secure financing, and procure the next step of the project.
CONSTRUCTION AND OPERATION:	Eskom is in the process of procuring a full engineering, procurement and construction (EPC) contractor.[1] Eskom chose a two-step tendering process including a competitive dialogue with the aim to ensure that the EPC contract is optimally designed. It is expected to be a fully-wrapped turnkey contract to carry out several key tasks: procure the necessary technology to fit the Optimized Design (e.g. solar field, power block, local content), arrange contracting, warranties and any sub-contracts, construct and commission the plant, then operate the plant for five years while training Eskom staff for the handover and minimizing any integration risks. Eskom will continue to contribute its experience on connecting the plant to the grid. Given the stringency of lender procurement procedures (including minimum levels of expertise with the technology and financial security tests), the EPC contractor is expected to have a strong balance sheet with the ability to internalize risks with little impact on Eskom and South Africa/lenders.

1 The procurement process for an EPC contractor is currently ongoing at the time of writing (February 2014). It is expected to follow a two-step World Bank process for tendering services including a competitive dialogue, the first stage without project costs, and the shortlisted few to submit full bids. Eskom chose this approach to ensure the optimal design of the EPC contract, which is expected to be awarded in 2015.

private sector actors for risk management purposes during design and construction/early operation.[2]

At the same time, and an important lender requirement, Eskom benefits by securing staff capacity building/training/skill transfers during both OE and EPC processes. This is vital for any future involvement of Eskom in CSP as developer. It will also reassure the lenders and the Government of South Africa which have provided guarantees on most of the lending.[3] Furthermore, experience with the technology will help develop the CSP market in South Africa as Eskom is the responsible energy utility for the private sector, ultimately connecting CSP plants to the grid and remunerating them via PPAs.

While this risk allocation mechanism allows Eskom to shift the technology risk to the private sector, Eskom CSP still remains one of the few CSP projects worldwide, where the technology provider does not provide equity to the project finance (BNEF, 2014).

2 The 100 MW Sere Windfarm is the first. Both Eskom CSP and Sere projects are recipients of CTF funding.

3 We do not have access to lending contractual terms including the use of guarantees; we understand that the IBRD, AfDB and CIF CTF lending all received GoSA guarantees. The AFD contribution did not.

In this respect, the Eskom CSP provides an opportunity for Eskom to develop a new business model that would allow them to share costs and risks associated with implementing new technologies across public and private partners. This would result in the sharing of the risks mentioned above and would reduce the likelihood of unforeseen delays and cost overruns across all stages of the project cycle.

Risk of not securing enough suitable capital

The IFIs 'club lending' helped Eskom to mitigate its main financing risk, the securing of enough suitable capital, but brought additional risks with it. To meet project costs, Eskom raised low-cost debt from several international finance institutions (IFIs). First, Eskom needed significant time to coordinate and form a "club lending group". Second, the group needed to develop a finer understanding of and confidence with the technology, as it was new to many of the parties involved. Finally, Eskom needed to manage differences between lenders' requirements, internal processes (technology selection/procurement) and policy interactions (such as national competition acts).

NEED FOR GOVERNMENT LOAN GUARANTEES	The World Bank and AfDB (including the CTF following WB procedures) require a government guarantee as part of their lending. This guarantee can be expected to be called in the case of Eskom defaulting on the loans.[1] We expect the granting process to be relatively smooth given that both Eskom and the National Treasury of South Africa are experienced in organizing similar guarantees for lending and procuring. However, given different potential lenders involved and almost USD 900 million in potential guarantees,[2] it may have presented additional complexities in its development.
NEED FOR POLITICAL APPROVALS AND EXEMPTIONS	World Bank lending processes require that competition in tendering or procuring services is unrestricted on any level. However, South Africa, like many developing countries, requires a certain share of local content to be included in many activities, including energy project investments. This is enacted through national policy such as the PPPFA.[3] Since lender processes require a fully competitive procurement process, an exemption is required from this local content provision before procurement can occur. Gaining or reinstating such an exemption – if justifiable - can cause a delay in the disbursement of lending and the procurement process, as seen in the case of Eskom CSP.
REQUIREMENTS FOR ENGINEERING SERVICES PROCUREMENT	Lenders require the borrower to comply with tendering processes for procuring engineering services and technology. In Eskom CSP, a two-step World Bank-approved approach will be adopted.[4] World Bank rules require this process to be as transparent and nondiscriminatory as possible. In addition, bidders (the OE or EPC contractors in Eskom CSP) must also prove certain eligibility criteria including demonstrating expertise and experience in the topic (e.g. minimum number of years involved in the sector, or minimum capacities of previous projects), or a certain degree of financial health (e.g. meeting or exceeding balance sheet 'tests'),[5] to show they are able to fulfill the safeguards set by the lenders' policies. Under early market conditions, such as CSP power tower with a limited number of suitable providers of technology and services, this approach might struggle to ensure that enough experienced technology providers from different countries participate in the bid. Moreover, given the risks associated with the early technology development cycle, Eskom and the lenders have agreed to discussions with prospective bidders to ensure that risks are adequately addressed in the structuring of the project and that the most suitable, experienced and cost competitive provider is awarded the contract.

FINANCIAL CLOSURE	Differences in timing between financial procedures of equity and debt providers and determining more accurate project costs resulted in a delay to procuring technology. Lenders require total project financing to be closed, or achieving a higher level of accuracy for project cost (GoSA/CIF, 2013), before disbursing funds. Conversely, Eskom procedures require cost estimates to be within a minimum error range, and lending to be secured, before generating an internal 'business case' which ultimately serves to release the project for execution by Eskom board of directors. In other words, the lack of acceptable cost estimates pushed financial closure forward, which delayed a more accurate cost estimate for the technology procurement process. One major task of the OE was to optimize the design, achieve an acceptable level of cost accuracy for Eskom internal processes, and thereby close financing.
FOREIGN EXCHANGE RATE RISK	The project involves lending from six international finance institutions, totaling almost USD 1 billion (in US Dollar/USD and Euro/EUR denominations), in currencies that are different from the one in which revenues are generated (South African Rand/ZAR).[6] Risks from volatile currency exchange rate place pressure on the financing of the project, as the Rand devalued almost 30% against the dollar in the period 2010 to 2014.[7] Eskom internalizes the foreign exchange rate risk by financing the project on its balance sheet. The company has extensive experience and the in-house capacity to manage foreign exchange rate risk as they handle business in approximately nine different currencies.[8] However, the foreign exchange rate risk increases the cost of debt. Multilateral bank loans are currently being issued at less than 2% in foreign currency terms, while local currency commercial loans for CSP projects in South Africa are closer to 12% in Rand. While the foreign public debt has lower interest rates than local lenders, the cost of foreign exchange hedging has to be factored in to the ultimate pricing of debt raised from these sources. The cost for hedging the related foreign exchange rate risk, at current rates can increase the cost of debt by up to 8% (includes interest rate differential and credit spreads), depending on the currency and the degree of hedging employed.[9] This can reduce the positive impact of concessional debt.
ALIGNMENT OF PROCUREMENT PROCEDURES AND STANDARDS	Alignment of procurement procedures and standards, and the potential for conflicting outcomes in the delivery of the project may yet further contribute to an extended execution period and additional costs. Eskom has to manage this whilst ensuring the structuring of the project execution remains sound. Ultimately though, given that this project is being financed on balance sheet, the risk associated with the structuring of the project remains squarely with Eskom. As such this requires that the risks associated with the structuring is managed to ensure the efficacy of delivery and legitimate recovery of the costs. Harmonization amongst the lenders will remain a challenge as each lender may have slightly different development outcomes in mind as well as different terms, conditions and requirements associated with the loans. These will only become transparent as the procurement process is concluded.

1 Default conditions associated with these loan guarantees are confidential. It is unknown if the other lenders also receive a government guarantee.

2 The AFD contribution did not receive a guarantee.

3 Preferential Procurement Policy Framework Act of 2000 (PPPFA). Mandates that procurement of services and technology within state representatives (including Eskom as state-owned entity) should work to support historically disadvantages individuals in fair, transparent, cost effective and competitive ways.

4 The procurement process for an EPC contractor is currently ongoing at the time of writing (February 2014). It is expected to follow a two-step World Bank process for tendering services, this will involve pre-qualification of preferred bidders where the pre-qualified bidders will be requested to submit bids without pricing. The process will then provide for exploratory dialogues where parties on both sides will be able to clarify and discuss a range of matters related to the structuring of the project. Eskom will use these dialogues to draft a final request for proposal to bidders whereupon the bidders will submit their final bids including pricing. Eskom chose this approach to ensure the optimal design of the EPC contract, which is expected to be awarded in 2015.

5 Including equity to debt ratios, outstanding debt exposure, and diversification of assets.

6 Eskom chose to request only loans in USD or EUR while some of the lenders could have provided ZAR.

7 2010 ZAR was ZAR 7.5 to USD 1. Current rates are closer to ZAR 11 to USD 1.

8 Eskom personal communication.

9 In this calculation n 2% increase would correspond to a 50% hedge ratio, while an 8% increase would correspond to a 100% hedge ratio (completely eliminating currency risk). However, currency risk would also affect the cost of floating-rate loans denominated in Rand – at the time of writing it was unclear whether privately financed CSP project in South Africa were employing floating or fixed rate commercial loans

5. Effectiveness, Replication and Scale-up - comparing the role of public financing in South Africa's CSP projects

5.1 Effectiveness over time

- If successful, Eskom CSP could provide important non-financial benefits such as stakeholder learning, job creation, and greenhouse gas emission reduction.
- By committing 60% of its funds to CSP, the CTF Investment Plan for South Africa is driving the development of the technology in the country: encouraging Eskom to climate-diversify its energy portfolio, giving confidence to other lenders and, importantly, by reassuring national ministries.
- Differences between Eskom and the IPPs as project developers, including the financing structure, are perhaps too different to compare on a level playing field basis.
- Eskom CSP demonstrates that public support is still required to create local content, drive cost reductions and deliver on the global expectations of CSP.

We evaluate the effectiveness of the Eskom CSP project against its immediate outputs, interim benefits and long-term impacts (see Table 3). The table illustrates that while the Eskom CSP project is yet to deliver on most of its more obvious or tangible outputs, it has achieved some on a preliminary basis, and may have helped to address some early vintage barriers associated with CSP in South Africa.

Even without a fully commissioned project, we can still track some of the immediate outputs and their interim benefits, related to learning and lowering vintage costs. These lessons learned are difficult to quantify, but are likely important to help reduce future costs and risks for subsequent projects in South Africa and further afield. Outputs to date include:

- **In-house learning**: The company has adapted policies and procedures to the specifics of the new technology. Furthermore, current Eskom staff benefits from external expert advice on all aspects of the developing and operating stage. In-house learning will smooth Eskom's involvement in projects in the country as either an investor or project developer for future CSP (and even other renewable) projects, and as the energy utility responsible for connecting the private CSP plants and managing the generated electricity once plants are commissioned and connected to the grid.
- **Funding vintage cost**: The early entry by Eskom ultimately prepared the ground for future CSP developments in the country. Some of the costs of the Eskom CSP projects can be best described as vintage cost; in other words, development costs related to CSP in South Africa that cannot be recovered by Eskom through Eskom CSP but can benefit the future development of CSP in the country. Learnings from the Eskom CSP for other CSP project developers may help reduce future transaction costs and risks for subsequent projects.[1] Achievements that lower the vintage costs include, for example, the long track-record of solar data to determine the best resource locations for CSP in the country, and suitable technologies and components of CSP. By undertaking resource and technology investigations since 1998, Eskom contributed to the reliability of data on solar and water resources, land, and energy system operation.[2]

The following interim benefits are expected but cannot yet be observed. These will comprise of tangible or quantifiable results like renewable power generation or greenhouse gas emission reduction, technology cost reduction, system operation improvement, or job creation and local development.

- **Meeting energy security, renewable energy and emissions reduction targets**: Successful implementation of renewable energy projects such as Eskom CSP is expected to help South Africa meet its conditional commitment[3] to reduce emissions by 34% by 2020 compared

1 Interestingly, key Eskom's CSP personnel moved companies in recent years, including taking up positions in private CSP developers in South Africa.

2 Experiences with CSP development in India showed that the lack of reliable resource data increased the risk of underperformance and lead to delays (Stadelmann et al. 2014b).

3 The commitment is conditional on a global climate agreement and South Africa receiving financial/technological/capacity building support from developed countries.

to business-as-usual and their ambitious clean energy build-out plans (additional 20 GW of new renewable energy capacity by 2030, of which 3.3 GW is expected to be CSP). This project will provide the following criteria:

» **Production of clean energy**: The plant is projected to produce on average 500 GWh of clean energy per year. This is approximately equal to the annual consumption of 200,000 South African households in 2010.[4]

» **Greenhouse gas emission reduction**: Assuming the plant replaces the average electricity mix in the country, it will reduce greenhouse gas emissions by around 450,000 tonnes per year – around 0.1 % of South African emissions in 2011 (IEA, 2014).

» **Improving green credentials of South Africa**: South Africa has one of the lowest penetrations of renewable energy in major economies. By undertaking CSP investment with storage, the country is aiming to move away from its reliance on coal for meeting baseload energy demand. As a first mover, Eskom helped to build awareness of CSP's technology potential for the country's energy security, renewable energy, and climate targets.

- **Cost reduction in CSP power tower**: Eskom CSP offers a learning opportunity by developing a large-scale tower project with significant storage – this technology is deemed most suitable for the country, with potentially the lowest cost of energy in the long-term (EPRI, 2012). Furthermore, this technology configuration is expected to provide a higher cost reduction potential than other CSP configurations (ESMAP, 2013). According to analysis by the International Institute for Applied Systems Analysis, every time the total installed generation capacity for a given technology doubles,[5] the costs fall by around 10-15% on account of learning and improved economies of scale (WB, 2011). Technology providers' learning during the project planning, installation and operation should lead to cost reductions in CSP power tower technology worldwide, as the project is the first of this size and one of the first of its kind. While the BNEF renewable energy project database (BNEF, 2014) indicates that only 500 MW of CSP power tower projects are operating worldwide. The impact of successfully installing and commissioning a 100 MW CSP power tower project bears the potential for significant cost reductions.

- **Local content and stakeholder learning**: Critical CSP knowledge and technology will be exported from the U.S. and European countries to South Africa. Increased skills in planning and installation, operation of a power tower plant, as well as the establishment of a local supply chain and infrastructure should lead to cost reduction of CSP in South Africa. Developing a local supply chain is a primary objective of South African policymakers and public lenders since it creates local jobs and improves the region's wealth. With CSP power tower technology, the potential for local content is higher than other CSP technologies in South Africa in the long run (Fichtner, 2010 & WB, 2011).[6] At the national level, a larger pipeline of CSP projects and larger individual projects (>100 MW)[7] across all CSP designs might be required in order to lift local content in South African CSP beyond the current focus on assembly and into manufacturing.

- **Socio-economic benefits**: While continuous learning will drive down cost, the demand for skilled workers is expected to create 2000 direct and 100 permanent jobs during construction (AfDB, 2013), and support the provision of local content. While early expectations from AfDB are that up to 30% of project components will be sourced from the local market, resulting in an injection of around USD 350 million into the local economy, discussions with stakeholders indicate that recent expectations are 45% or above. At the same time, the project

4 Assuming an average monthly electricity usage of 200 kWh per household.

5 For CSP towers, the BNEF renewable energy project database (BNEF, 2014) indicates that only 500 MW of are installed and commissioned worldwide, with only 100 MW outside of US spread across 12 relatively small projects. If commissioned, Eskom CSP will be the largest outside of the 392 MW Ivanpah tower project and the 110 MW Crescent Dunes Solar Energy Project. An additional 1500 MW of tower CSP projects are in development, 60% of which is once again in the US. Only two US projects will have more storage than Eskom CSP.

6 In addition, the Fichtner study highlighted that molten-salt storage based tower technology is expected to be the leading technology for utility scale CSP plant with high capacity factors.

7 The current private CSP process aims to do this, however, has a cap on the size of individual projects. For CSP, currently set at 100 MW. A higher cap is under discussion for further bidding rounds.

(and further projects in the Upington area) will strengthen the surrounding energy system by bulking up current networks and helping to expand to areas without electricity network connections. In fact, Eskom CSP, along with the other CSP projects, could promote regional integration as it may facilitate the replication of the technologies in the region in the medium term even into Botswana and Namibia (AfDB, 2010a).

- **Replication and scale up in other locations and geographies**: Proof of technical design and related system performance may help to realize the real value of the technology, in particular of large volumes of storage, and incentivize its replication and scale up. It may also help to reduce risk perception among all stakeholders including project developers, host governments, and possible future lenders.
- **Improving energy system stability**: Storage can help renewable energy technologies generate energy during variable supply of the natural resource, in this case solar energy from the sun. With Eskom CSP, the company has access to 9-12 hours of energy potential, which can be used to stabilize the energy system by filling demand and supply gaps. If managed efficiently by the energy system operator, it can also help to smooth system operation, and even reduce system prices by offering peak-load power supply which is currently provided by expensive imported fossil fuels like oil or gas.

5.2 Effectiveness compared with other CSP plants plants

The differences between Eskom and the independent power producers (IPPs) as project developers are perhaps too large to compare their CSP projects on a level playing field basis. South Africa provides, to some

Table 3: Summary of the effectiveness of the Eskom CSP project

<table>
<tr><th>INPUT</th><th>OUTPUT</th><th>INTERIM BENEFITS</th><th>OUTCOME</th></tr>
<tr><td rowspan="7">Public equity: gap filling
Public debt:~USD 995 million
Public support: Loan guarantee by Government of South Africa.</td><td>✓ Studies on solar and water resources, land, and energy system.</td><td>✓ Funded vintage cost.</td><td>x Internal rate of return for investment: not calculated because project is included in regulated asset base.</td></tr>
<tr><td>✓ Eskom learning in-house.</td><td>✓ Facilitate Eskom's involvement in CSP projects in the country.</td><td>x Improvement of economies of scale in South Africa and beyond. Potential of regional uptake</td></tr>
<tr><td rowspan="5">x Installed clean energy capacity: 100 MW.
x Installed storage capacity: 9-12 hours.
x Diversification of Eskom's energy mix</td><td>x Proof of technical design.</td><td rowspan="2">x Enhance understanding of the extent to which CSP and its capacity for storage can be used to reduce the system costs</td></tr>
<tr><td>x Improved stability of the power system through efficient operation of storage.</td></tr>
<tr><td>x Clean energy: 500 GWh/year supplying 200.000 South African households.</td><td rowspan="2">x Support for meeting South Africa's energy security, renewable energy and climate targets.</td></tr>
<tr><td>x Greenhouse gas emission reduction: around 450,000 tonnes of CO2 (equivalent) per year.</td></tr>
<tr><td>x Learnings by technology providers.</td><td>x Replication and scale up in South Africa and abroad</td></tr>
<tr><td rowspan="2">Technology: Warrantees/ guarantees by technology provider.</td><td rowspan="2">x Exports and technology transfer to South Africa</td><td>x Learnings by service providers</td><td>x Cost reduction in CSP power tower technology and storage.</td></tr>
<tr><td>x Facilitate local supply chain & infrastructure for further CSP plants.</td><td>x Socio-economic benefits: 2,000 direct and 100 permanent jobs, injection of at least USD 350 million into the local economy from sourcing local content.</td></tr>
</table>

Note: Ticks are where the effectiveness indicator has been achieved, 'x' is where it has not yet been achieved given the early stage of the project.

Table 4: Comparison of characteristics of Eskom CSP and IPP Projects. Source: CPI

CHARACTERISTIC	ESKOM	INDEPENDENT PROJECT DEVELOPERS
Ownership structure	Fully state-owned and responsible to political targets	Private-public
Asset Base	Large, diverse and vertically-integrated (including generation, system operation and network ownership)	Smaller and focused
Expertise	Fossil-fuel focus, system operation and network investment. No non-hydro renewable generation to date.	Niche CSP/solar energy developers
Return expectation	Regulated, asset-based revenues funded through electricity tariffs paid by consumers (or 0.08 USD/kWh in 2013/2014)	Guaranteed long-term power purchase agreement with Eskom (round 1: fixed 2.686 ZAR/kWh (0.33 USD/kWh), round 2: fixed 2.51 ZAR/kWh (0.30 USD/kWh), round 3: averaged 1.64 ZAR/kWh (0.20 USD/kWh) with a 270% premium for production during peak hours)
Risk expectation	Risk-averse to technology risk	Risk-takers on technology risk

extent, a distinctive setting for comparing the effectiveness of several CSP projects, each employing different financing, technologies and scales. Although no CSP project is yet commissioned in South Africa, the developer and project expectations offer a glimpse of the challenges that are unique to Eskom.

- **As a state-owned utility, Eskom has the obligation to provide and transport baseload electricity even if IPPs cannot deliver energy**. Eskom needs to ensure that capital expenditure, operating, and maintenance costs can be paid by the revenues that the company creates from the regulated tariff charged to consumers, for whom electricity needs to stay affordable. Therefore, the company is obliged to avoid unplanned cost and eliminate risks carefully. Its energy portfolio shows predominantly low-cost, low-risk coal generation.
- **IPPs are smaller in asset-value than Eskom and focus on their field of expertise e.g. niche CSP technology providers/developers**. They have entered quickly and seem to develop and commission their CSP plants after a much shorter development period than Eskom CSP. Their revenue stems from a long-term power purchase agreement (PPA) with Eskom that is guaranteed by the Government of South Africa. They take the technology risk, meaning that only if their projects succeed and start to supply electricity will costs accrue to the final consumer.

While IPPs CSP projects suffice typical financial investment criteria, Eskom CSP has wider development objectives such as to help bring CSP power tower technology costs down (see section 5.1). The Eskom CSP technology configuration is not yet commercially bankable due to a lack of a track record of operational plants and high risks that commercial players are unwilling to undertake. It is important for Eskom CSP to succeed, as it could unlock this innovative technology configuration in the country and further afield. The Eskom CSP plant lies outside of the REIPPP,[8] which currently includes five CSP projects awarded a total of 400 MW in capacity. The level of innovation in the Eskom CSP project is clear when compared with IPP CSP projects and even when compared globally using existing CSP databases (Table 5) and sector reports (Stadelmann et al. 2014a):[9]

- **The Eskom CSP technology configuration requires a high share of public support - in line with financing schemes for CSP power tower projects internationally**. Among the CSP projects in South Africa, there is only one other CSP power tower currently planned - with less generation capacity (50 MW) and shorter storage (2 hours) than Eskom CSP. Despite the less challenging technology configuration, this project still raises 100% of its debt finance from public sources. CSP power tower projects in the US also receive significant public support in the form of investment tax credits of up to 30% of the investment value; federal loan guarantees

8 The Renewable Energy Independent Power Producers' Procurement Programme (REIPPPP) is designed to improve energy security and economic development, and encourage low-carbon energy.

9 At 100 MW, Eskom CSP is five times larger in capacity than other commissioned CSP tower projects outside of the US. And with 9-12 hours storage, is one of the highest in the world.

and/or capital provided by the Federal Financing Bank.

- **Eskom finances the project almost solely via debt**. The financing of the only other CSP power tower project planned in South Africa is weighted towards a higher equity stake, while the high debt share for Eskom CSP together with the concessionality is expected to decrease the cost of capital for Eskom. Furthermore, the Eskom CSP project is one of the few worldwide where technology providers don't have an equity stake.

Table 5 briefly outlines the projects included in the IPP process so far and compares them with the Eskom CSP project.

5.3 Scale-up and replication

The replication potential of CSP plants in southern Africa is vast. In South Africa alone, Eskom estimates a potential 40 GW of commercially feasible CSP in the Northern and Western Cape provinces. Taking it further into Namibia and Botswana could double or treble this potential (AfDB, 2010a; CIF, 2009). Since CSP investments are still currently perceived as high risk, public

Table 5: Overview of South Africa's CSP Projects.

CSP PROJECTS IN SOUTH AFRICA							OTHER CSP POWER TOWER PROJECTS	
PROJECT	KHI SOLAR ONE	KAXU SOLAR ONE	BOKPOORT CSP	XINA SOLAR ONE	ILANGALETHU CSP ONE	ESKOM CSP	IVANPAH (US)	CRESCENT DUNES (US)
SIZE (MW)	50	100	50	100	100	100	392	110
STORAGE (HRS)	2	3	9	5	*TBD*	9-12	0	10
TECHNOLOGY	Power tower	Parabolic trough	Parabolic trough	Parabolic trough	Parabolic trough	Power tower	Power tower	Power tower
ENERGY OUTPUT (GWH)	180	320	230	300 (est.)	N/A	470-525	1080	485
CAPACITY FACTOR	41%	37%	53%	34%	N/A	60+%	32%	50%
HOUSEHOLDS POWERED IN SOUTH AFRICA/ YEAR	45,000	80,000	-	90,000	-	200,000	-	-
AVOIDED EMISSIONS TCO2E / YEAR	183,000	315,000	230,000	315,000	-	450,000	-	-
PROJECT DEVELOPER	Abengoa SA	Abengoa SA	ACWA Power/ SolAfrica	Abengoa SA	Emvelo	Eskom	BrightSource	Solar Reserve
PROJECT COST (USD MILLION)	445	900-1000	450-500	*TBD*	*TBD*	1000	2200	1040
FINANCING STRUCTURE	40% Equity: private, public 60% Debt: public*	30% Equity: private, public 70% Debt: private (ca. 50%), public (ca. 50%)	29% Equity: 71% Debt:	*TBD*	*TBD*	Equity: public (if any) Up to 100% Debt: public	25% Equity: 75% Debt: (covered by public loan guarantees)	26% Equity: 74% Debt: (with a grant-element)

*Khi Solar One and KaXu Solar One also receive concessional debt from the CTF through IFC. Global comparison limited to utilities with 50 MW and above.
Source: CPI; BNEF, 2014; CSP Today, 2014; CSP World, 2014; developers (Abengoa, Emvelo, Eskom, ACWA/SolAfrica); NREL.[1]

1 Available at: http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=62 and http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=60.

support is critical to overcome the hurdles to commercially-oriented project developers.

The role of CTF funding in scaling up CSP in South Africa

Currently, almost 60% of South Africa's USD 500 million CTF financing is allocated to CSP: USD 250 million to Eskom CSP, and USD 42 million to other CSP projects in the private IPP process. CTF support to CSP aims to foster the low-carbon objectives and priorities outlined in South Africa's Long Term Mitigation Scenarios including the scale up of CSP deployment in the country.[10]

The engagement with CTF was a catalyst to revisiting the viability of the 100 MW Eskom CSP. Lessons from Eskom CSP highlight that future funding for CSP from CTF or other IFIs will need to properly account for the national and institutional context to avoid project delays and additional cost. Given the country's target for achieving energy security, renewable energy and climate goals at an affordable price to the consumer, Eskom needed to make a conscious choice before investing limited funds in an innovative project like Eskom CSP. CTF's support to Eskom in the Eskom CSP project aimed to change the perception of the traditional utility by shifting its typical investment focus on coal toward untapped but more costly renewable energy resources (GoSA/CIF, 2013). It helped the project proceed given the volume, low cost and long tenor of the CTF loan. By communicating its plans the CTF attracted the interest of other IFIs and reassured national ministries to provide political backing. The process introduced risks that required careful management from Eskom, the government and lenders (which are discussed in Section 4).

CTF chose to support the 50 MW Khi Solar One and the 100 MW KaXu Solar One in the private CSP process with the aim of bringing CSP closer to market, reducing costs through capacity building, and encouraging transformation of the private energy sector by establishing a series of direct, project level interventions. At the time of the initial lending to the Eskom CSP project, Eskom was the only real player in the development of South Africa's power sector. Support of IPPs set out to demonstrate that private sector participation in the power sector (particularly the renewable energy sector) can be successful in South Africa. Although projects with a maximum capacity of 100 MW using more commercial parabolic trough technology with limited storage are unlikely to drive the technology cost down significantly, they will address some of the early entrant barriers related to establishing precedents and will help build up knowledge along the way.

Overcoming barriers for replication of CSP power tower project

Eskom CSP as a fully publicly financed and highly innovative project is unlikely to be replicable as such. Low-cost foreign debt makes up most of Eskom CSP's total project cost. Considering the successful facilitation of CSP development in the country, it is unlikely that involved international public actors will be ready to again provide USD 995 million of low-cost debt to a CSP project in South Africa.

It is crucial to unlock private developer involvement in highly innovative CSP power tower projects, as the availability of concessional financing and public balance sheet financing is limited. Despite its potential for cost reduction and building up local supply chains, the technology is currently still at an early stage, and therefore presents many development uncertainties and challenges to its investors. Examples from other emerging economies show potential solutions for how to address this hurdle without providing 100% public project finance. While the 100MW NOOR III power tower in Morocco also raises 100% of its debt from public sources, it was setup as a PPP between a public agency and the project developer and technology providers who all share the project risks (MASEN, 2013).

Experiences from Eskom CSP also stressed that bringing in strong partners with technical knowledge and expertise, proper foreign exchange rate risk mitigation and careful management of expectations are essential for successful execution. The efforts from Eskom identified early potential challenges and lessons that are common across developers and CSP projects. Some findings from Eskom CSP for replication in future projects include:

- Projects need a sponsor with experience of country context with a strong balance sheet to internalize 'mainstream' unmanageable risks;
- A strong/committed OE for price discovery, optimizing designs and risk identification and

10 The 2009 Clean Technology Investment Plan (GoSA/CIF, 2013) was arranged to fund a variety of measures including renewable energy, energy efficiency and sustainable transport. In 2013, the plan was adjusted by reallocating funds for energy efficiency sub-components to either private renewable energy or public transport in 2013. This included the cancellation of a pre-approved USD 7.5 million for energy efficiency, and the not-yet-approved USD 50 million for solar water heaters. See (GoSA/CIF, 2013) for details.

an experienced/capable EPC with significant and sufficient 'risk wrapping' and procurement strategies help to reduce technology risks;

- Early preparations and investigations can take more time than for other more conventional projects, but yet help to set realistic expectations and avoid delays;
- Proper foreign exchange rate risk mitigation measures are necessary in all cases be it for paying back foreign currency loans or buying imported technology, while being financed with local currency; and
- Effective management and coordination of lenders takes time.

Local and foreign commercial banks could play a key role in developing CSP power tower technologies, if they are willing to take more risks. Both tower projects in South Africa (Eskom CSP and the 50 MW Khi Solar One IPP project) only receive debt from public sources. In the case of Eskom CSP, commercial, project-financed lending was not even possible given its balance sheet financed nature. It is unclear how far South Africa's existing lending pool can go with four commercial banks[11] and two local development banks funding from local sources.[12] Still, local commercial lending appetite to renewable energy projects would limit the extent to which concessional lending is needed. International commercial banks can equally provide additional funding, however, as in Eskom CSP, are likely to face volatile and significant foreign exchange rate risks. The government is aware of this difficulty by acknowledging that it "forces developers into a shorter-term contacting paradigm in order to hedge their currency exposure and it limits the interest from potential developers" (DoE, 2013), and as such is considering dollar denominated tariffs.

11 In alphabetical order: Absa Capital/Barclays, NedBank Capital, FirstRand Bank, Standard Bank. An important factor in the IPP process is the requirement to use locally sourced commercial bank investment. These banks have been most active (with a requirement to be involved in each IPP project

12 Industrial Development Corporation and Development Bank of South Africa.

6. Conclusion

This paper is part of a larger project for the Climate Investment Funds that analyzes which forms of public finance and policies can enable the scale up of CSP as a promising but high-cost clean energy technology. However, CSP has not been deployed at the scale of other renewables, and costs are still high. Therefore, more deployment experience is needed to increase learning and make the technology more competitive.

The Eskom CSP project in South Africa is one of the most ambitious and technically challenging CSP projects currently in development outside of the US both with respect to its proposed technology choice (power tower), generating capacity (100 MW), and the 9-12 hours of storage. Its technology configuration offers a higher potential for cost reduction, building up local supply chains and energy security than other projects. Once commissioned towards 2019, Eskom CSP is expected to deliver clean energy to around 200,000 South African households. Over 10 years since early plans and despite significant extensions of its development period and delays in the start of construction, Eskom CSP is expected to provide significant lessons on building and financing CSP power tower projects (only 500 MW of which are currently commissioned worldwide) and the use of dry cooling, and molten-salt thermal storage.

Without the political support and concessional lending from international financial institutions (IFIs), Eskom, the national state-owned energy utility, was unlikely to develop Eskom CSP. However, foreign debt implied additional risks Eskom had to manage. One of the first lenders to the project with the largest contribution, the Clean Technology Fund (CTF) provided a 'catalytic effect' to encourage Eskom to climate-diversify its energy portfolio. The CTF lending also gave confidence to other lenders and importantly, reassured national ministries. The use of club lending from different IFIs lowered the risk of securing financing but posed additional risks on Eskom, such as delays arising from IFIs' diverse administrative and procurement requirements, and the sensitivity of project returns to currency exchange rates. Eskom handled these risks through complying with requirements and using in-house capacity on exchange rate hedging, which proved critical to project cost, but it also meant that the value of concessionality in the early loans has decreased.

The developer Eskom had to use specific risk management measures to shift risks to appropriate project participants with the ability and expertise to manage them. Such measures include outsourcing expert design services, fully wrapping risks within a procurement/construction contract, and securing skill transfer services.

Future projects accessing foreign debt from individual or groups of IFIs would benefit from context-specific policy support and financing, since the drivers for and process of project development vary according to technology maturity, national interests and project developer expertise. We found four issues in particular that, if successfully addressed by the appropriate actors, would speed the implementation of projects and lower their costs:

- **Technology maturity**: IFIs can help to ensure that projects contract the most suitable, experienced and cost competitive technology and service providers by adapting procurement standards appropriate to a technology's stage of development.
- **Administrative burden**: Large projects with many involved IFIs would benefit from a harmonized approach to procedures and standards, including reacting to national policy requirements..
- **Foreign exchange rate risks from low-cost foreign debt**: Project sponsors and lenders need to investigate what foreign exchange rate risks exist and respond to them accordingly. Our analysis shows that project sponsors with a strong balance sheet and existing expertise or capacity can overcome or internalize more "mainstream" risks such as those resulting from the foreign exchange of currency.

The differences between Eskom and independent power producers (IPPs) as project developers are perhaps too large to compare their CSP projects on a level playing field basis. The Eskom CSP plant lies outside of the Renewable Energy Independent Power Producers' Procurement Programme (REIPPPP) which currently includes five CSP projects being developed by IPPs. These IPPs have moved quickly to develop and potentially commission 400 MW of CSP plants in the next three or four years. Furthermore, these CSP projects are financed with less public funding than Eskom CSP. Comparison between Eskom CSP and other IPP projects is difficult, however. Among the CSP projects in South Africa, there is only one other CSP power tower currently planned, yet it has less generation capacity (50 MW) and shorter storage (2 hours) than Eskom CSP but still, like Eskom CSP, required 100% public debt. In contrast to IPPs, Eskom is a state-owned utility, obliging it to ensure the provision of baseload electricity and socio-economic benefits. While Eskom CSP places a financial burden on Eskom's balance sheet in the short-run, its innovative technical configuration promises the fulfilment of these obligations in the long run. In addition, IPPs earn their revenues through long-term power purchase agreements with Eskom (up to 0.33 USD/kWh), whereas Eskom earns regulated revenues. Eskom has to fund its capital and operational expenses, and the power purchase agreements with the private sector renewable energy project developers from its average electricity selling price (0.08 USD/kWh).

Public sources of finance are – at least in the short-term – essential to bridge the viability gap between CSP power tower and cheaper alternatives and to deliver substantial global technology learning and cost reduction that could lead to replication and scaling up of projects in South Africa and beyond. In the long-term, relying on majority shares of public resources into CSP projects is unsustainable. Instead, the scale up of CSP power tower projects will require a shift to private and domestic investments. The potential to do so exists. The majority of CSP projects already shows direct private sector engagement via an equity stake in the project finance, which helps to share the risk among public and private actors. However, more deployment experience is needed before also private banks will be ready to finance larger power tower projects with longer storage like Eskom CSP.

7. References

African Development Bank (AfDB). 2009: Medupi Power Project: Appraisal Report. Available from: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/South%20Africa%20-%20Medupi%20%20Power%20Project.pdf

African Development Bank (AfDB). 2010a. Eskom Renewable Energy Investment Project - Environmental and Social Impact Assessment Summary. Available from: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/ESIA_Summary_Eskom%20Renewable%20Energy%20Investment%20Project_%20FINAL_%20July%202010.pdf

African Development Bank (AfDB). 2010b. Management Response to the Request for Verification of Compliance to AfDB Policies Regarding the Medupi Power Project. Available from: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Compliance-Review/MANAGEMENT%20RESPONSE%20TO%20THE%20REQUEST%20FOR%20VERIFICATION%20OF%20COMPLIANCE%20TO%20BANK%20%20POLICIES%20REGARDING%20THE%20MEDUPI%20POWER%20%20PROJECT.pdf

African Development Bank (AfDB). 2013. "Eskom Renewable Energy Investment Project"; [Internet]. [cited 2014 May 27], Available from: http://www.afdb.org/projects-and-operations/project-portfolio/project/p-za-f00-002/

Bloomberg New Energy Finance (BNEF). 2013. Personal communication. Cape Town, South Africa.

Bloomberg New Energy Finance (BNEF). 2014. "Projects and Assets Database: Renewable Energy Projects"; [Internet]. [cited 2014 January 27]. Available from: https://www.bnef.com/Projects (registration required).

CSP Today. 2014. CSP Today Markets Report 2014 – South Africa. CSP Today, London, UK.

CSP World. 2014. "CSP World Map"; [Internet]. [cited 2014 January 27]. Available from: http://www.csp-world.com/cspworldmap

Electric Power Research Institute (EPRI). 2012. Power Generation Technology Data for Integrated Resource Plan of South Africa (Technology Update). EPRI, Palo Alto, California.

Energy Information Administration (EIA). 2014. "International Energy Statistics Countries Database"; [Internet]". [cited 2014 May 26]. Available from: http://www.eia.gov/countries/

European Investment Bank (EIB). 2014. "Eskom Kiwano CSP Project"; [Internet]". [published 2013 October 18, cited 2014 May 26]. Available from: http://www.eib.org/projects/pipeline/2010/20100704.htm

Eskom. 2014. "Tariff history"; [Internet]. [cited 2014 May 26]. Available from: http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Pages/Tariff_History.aspx

ESMAP. 2013. Development of Local Supply Chain: The Missing Link for Concentrated Solar Power Projects in India. Washington: The World Bank. Available from: http://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP%20WB_Development%20of%20Local%20CSP%20Supply%20Chain%20in%20India_Full__Optimized.pdf

Fichtner. 2010. Technology Assessment of Concentrated Solar Power Technologies for a Site Specific Project in South Africa. Fichtner Consulting, Stuttgart, Germany. December 2010.

GeoSolar, 2011. Site Assessment of Solar Resource. GeoModel Solar, Slovakia. Available from: http://www.crses.sun.ac.za/files/research/publications/technical-reports/GeoModelSolar_SolarRes-Rep_58-01-2011_Upington_rev2.pdf

Department of Energy (DoE). 2009. Reserve Margin - IRP 2010 Input Parameter information sheet. Department of Energy (DoE), Government of South Africa. Available from: http://www.energy.gov.za/IRP/irp%20files/S2_Reserve_Margin.pdf

Department of Energy (DoE). 2013. Integrated Resource Plan for Electricity (IRP) 2010-2030 – Update Report 2013. Department of Energy (DoE), Government of South Africa. Available from: http://www.doe-irp.co.za/content/IRP2010_updatea.pdf

Government of South Africa (GoSA). 2009. "Address by President Jacob Zuma at UN Climate Change Conference; Copenhagen"; [Internet]. [published 2009 December 18, cited 2014 March 15]. Available at: http://www.thepresidency.gov.za/pebble.asp?relid=555

Government of South Africa (GoSA). 2011. National Climate Change Response White Paper. Pretoria, South Africa: Government of South Africa (GoSA). Available from: http://www.gov.za/documents/download.php?f=152942

Government of South Africa (GoSA)/Climate Investment Funds (CIF). 2009. Clean Technology Fund (CTF) Revised Investment Plan for South Africa (2009 Endorsed Version). Government of South Africa (GoSA)/Climate Investment Funds (CIF) Admin Unit. Available from: https://www.climate-investmentfunds.org/cifnet/sites/default/files/South%20Africa%20CTF%20Investment%20Plan%20-%20Endorsed.pdf

Government of South Africa (GoSA)/Climate Investment Funds (CIF). 2013. Clean Technology Fund (CTF) Update of CTF Investment Plan for South Africa (2013 Endorsed Version). Government of South Africa (GoSA)/Climate Investment Funds (CIF) Admin Unit. Available from: https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/CTF_TFC.12_6_Update_of_CTF_Investment_Plan_for_South_Africa_.pdf

International Energy Agency (IEA). 2010. CSP Technology Roadmap. Paris, France: International Energy Agency (IEA). Available from: https://www.iea.org/publications/freepublications/publication/csp_roadmap.pdf

International Renewable Energy Association (IRENA). 2014. "IRENA Renewable Energy Country Profiles"; [Internet]. [cited 2014 March 15]. Available from: http://www.irena.org/REmaps/africamap.aspx

International Renewable Energy Association (IRENA). 2014b. Southern African Power Pool: Planning and Prospects for Renewable Energy. Paris: International Renewable Energy Association. Available from: http://www.irena.org/DocumentDownloads/Publications/SAPP.pdf

MASEN. 2013. Seven Consortia Pre-Qualified for NOOR II and NOOR III. 2013: Moroccan Agency for Solar Energy. Available from: http://www.masen.org.ma/upload/news/NOOR_II_III_RFQ_Results_PR_2013_08_01_English.pdf

South African National Energy Development Institute (SANEDI). 2013. Wind Resource Maps for South Africa. Available from: http://www.sawea.org.za/images/stories/WASA_wind_resource_information_sheet_final.pdf

Stadelmann M, Frisari G, Boyd R, Feás, J. 2014a. The Role of Public Finance in CSP: Background and Approach to Measure its Effectiveness. Venice, Italy: Climate Policy Initiative (CPI). Available from: http://climatepolicyinitiative.org/wp-content/blogs.dir/2/files/2014/03/SGG-Brief-The-Role-of-Public-Finance-in-CSP-Background-and-Approach-to-Measure-its-Effectiveness.pdf

Stadelmann M, Frisari G, Konda, Ch. 2014b. The Role of Public Finance in CSP. Case Study: Rajasthan Sun Technique, India. Venice, Italy: Climate Policy Initiative (CPI). Available from: http://climatepolicyinitiative.org/wp-content/uploads/2014/03/SGG-Case-Study-The-Role-of-Public-Finance-in-CSP-Rajasthan-Sun-Technique-India.pdf

World Bank (WB). 2011. Project Appraisal Document on a Proposed Loan from the CTF in the Amount of USD 250 million to Eskom Guaranteed by the Republic of South Africa for the Eskom Renewables Support Project (Report No. 64634-ZA). Washington DC, USA: World Bank (WB). Available from: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2011/11/04/000386194_20111104004713/Rendered/INDEX/646340PAD0P1220Official0Use0Only090.txt

World Bank (WB)/International Bank for Reconstruction and Development (IBRD). 2012. Management Report and Recommendation in Response to the Inspection Panel Investigation Report -- South Africa Eskom Investment Support Project (IBRD Loan No. 78620-Za). Washington DC, USA: World Bank (WB)/ International Bank for Reconstruction and Development (IBRD). Available from: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1342195607215/ESKOM-Mgmt-Report-Recommendation-020312.pdf

World Bank (WB). 2014. "World Bank Data – South Africa"; [Internet]. [cited 2014 January 14]. Washington DC, USA: World Bank (WB). Available from: http://databank.worldbank.org/data/home.aspx

Annex 1 - Energy Policy of South Africa in the last 15 years

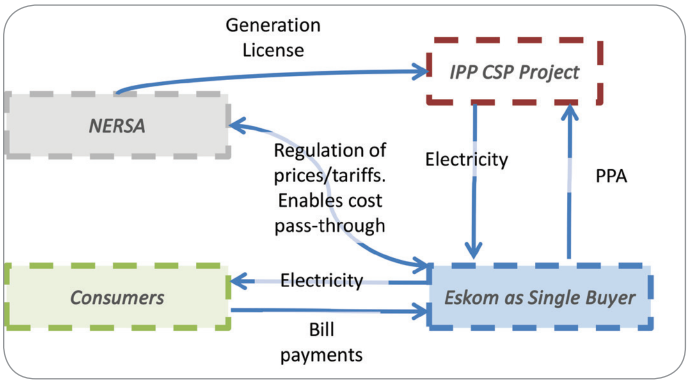
The most relevant policies to CSP, or most important to the energy sector, are listed in the table below.

POLICY	DESCRIPTION
1998 Energy White Paper	Proposes five principal objectives to reform the energy sector: increasing access to affordable energy services, improving energy governance, stimulating economic development, managing energy related environmental impacts, and securing local diversity through energy diversity. Also discusses energy market liberalization and the unbundling of Eskom.
2001 GoSA Cabinet Decision	Proposes that any new power generation investment should be split 70% by Eskom, and 30% by new players/IPPs.
2003/2004 White Papers on Renewable Energy Policy	Discusses the future role of renewable energy in the country, and sets an initial target to generate 10,000 GWh from renewable sources by 2013 (equivalent to approximately 4% of power generation).
2004 and 2006 Energy and Electricity Regulation Acts	Establishing an independent regulator, the National Energy Regulator of South Africa (NERSA), with powers to control the national pricing of Eskom's energy tariffs, license new generators such as IPPs, and regulate Eskom's energy networks. By establishing Multi-Year Price Determination (MYPD) periods, a regulatory control measure, NERSA determines any increase in electricity tariffs that Eskom will use to fund any new capital or operational investment for the control period.
2008 GoSA Cabinet Decision on Long-term Mitigation Scenario (LMS)	A comprehensive study of South African emissions trajectories and expectations, ensuring that the carbon emissions from all sources, including electricity generation, peak during 2020-2025, plateau for a decade, and then begin to decline thereafter.
2008 Electricity Pricing Policy	NERSA introduces a premium paid for energy generated from renewable sources.
2009 New Generation Regulations	NERSA introduces and publish guidelines for Renewable Energy Feed-in Tariffs (REFITs) paid to electricity supplied from wind, solar photovoltaic, landfill gas and CSP.
End-2009 GoSA Voluntary Commitment at UNFCCC Copenhagen	Agree to reduce BAU emissions 34% by 2020, then 44% reduction by 2025. Commitment is conditional on an international agreement; with financial, technical and building capacity support from Annex I countries.
2010/2011 GoSA Department of Energy 2010-2030 Integrated Resources Plan (IRP)	Underlying framework detailing the energy sector outlook from 2010 to 2030. Includes demand growth and investment expectations and technology specific capacity expansion plans, highlighting that 42% of new capacity added by 2030 will be renewable energy (equivalent to almost 20 GW). IPPs will be expected to make up most of the new capacity, along with Eskom contributions. CSP received a non-technology specific allocation of 1.2 GW (DoE, 2009).
2011 National Climate Change Response White Paper	Outlines a response strategy to climate change including priorities, programmes and strategies for mitigating and adapting to climate change.
2011 NERSA abandon REFIT, adopt Renewable Energy Bidding (REBID)	Establishes a competitive bidding process for IPP renewable energy contributions (REIPPP), in line with capacity allocations detailed in the IRP, with winners receiving a 20-year power purchase agreement (PPA) from Eskom for the energy generated. Rolled out over several bidding rounds/windows. See Section 5 for a discussion.
2013 Carbon Tax Policy Paper	Discusses the introduction of a carbon tax to certain sectors of the economy emitting more than 100,000 tonnes of CO_2 (equivalent) per year. Expected in two phases from 2015 to 2019, and 2020 to 2025. Later, implementation was delayed to 2016.
2013 Update to the 2010 IRP	The update to IRP 2010 has been circulated for comment and renewables continues to play a substantial role in the anticipated new generation mix. Allocations and expectations updated in light of a changed economic outlook. CSP allocation increased from 1.2 GW to 3.3 GW. The REIPPPP originated according to three overarching aims: • **Reducing carbon intensity.** An aim of the Integrated Resource Plan (IRP) for 2010-2030 is to reduce the carbon intensity of generation from approximately 0.912 kg CO_2(eq.)/kWh to 0.600 kg CO_2(eq.)/kWh by 2030. In order to get there, the current energy portfolio needs urgent diversification away from coal. • **Meeting energy security.** In order to continue its economic growth, South Africa needs to build new sources of energy and quickly. By learning from previous renewable energy support schemes (feed-in tariffs and other reverse auctioning/bidding processes), South Africa has created an IPP process that is robust, quick to develop, and increasingly attractive to commercial entities. • **Economic development opportunity.** The renewable energy sector is a new area of growth for the country and has been unexploited over the last decades. It offers economic growth that is green, with an additional social impact.

Annex 2 - South Africa's Renewable Energy Independent Power Producers' Procurement Programme (REIPPPP)

The government promotes CSP through the REIPPPP by inviting private developers to bid for allocated capacities of new build renewable energy power plants and receive a power purchase agreement with Eskom, set at a tariff (above market prices) that compensates them for their installation costs. See figure for organizational structure of the IPP process.

The bidding process is a two-step approach. The first **qualification phase** assesses projects according to the structure of the legal documents, land acquisition, financing availability, environmental consent, technical/economic development and bid guarantees. The second **evaluation phase** takes compliant bids and evaluates them on 1) the price relative to a bid ceiling set by energy ministry, accounting for 70% of the decision, and 2) the economic development potential, accounting for 30% of the decision.



In line with national objectives to build almost 20 GW of new renewable energy capacity by 2030, the first two bidding rounds for CSP allocated 200MW plus power purchase agreements to three CSP plants, and in third bidding round provisionally allocated a further 200 MW to another two CSP plants.

Early results from the bidding rounds of wind, solar photovoltaic (PV) and solar CSP have shown an **increase in competition** in terms of **interest of bids increasing and lowering success rates**. At the same time, the **tariffs have progressively declined through the rounds** (particularly in wind and PV), and there has been an **increase in interest from foreign developers**. CSP rounds one and two were undersubscribed, with 100% success rates.

Annex 3 - Public Lending

At the writing of this report, financing terms for all lenders were not finalized, nor were project costs (as the project had not yet begun construction and a final EPC contractor had not been identified). As such, we constructed a financial model for illustrative purposes, but did not focus on the financing details, many of which are yet unknown and others of which are subject to change. The CTF loan has a tenor of 40 years – we assumed the other DFIs would offer 20. We assumed an average cost of concessional debt in dollars of 2.5%, which is reflective of typical premia over LIBOR (which has been less than 0.5% for several years) at the time of the debt offering. We calculate the cost of hedging using actual market rates for US Dollar and South African Rand Bonds denominated bonds. Our estimates of project costs are drawn from World Bank's Project Appraisal documents. In order to estimate the value of the electricity, we use World Bank's "willingness to pay" estimate for South Africa, which estimates that South African consumers value CSP energy at 17.5 US cents/kWh.

LENDER	AMOUNT	CURRENCY	DETAILS (TENOR*) (YEARS)	DETAILS (RATE)	DETAILS (CONTINGENCY TERMS)	
CTF – WB + AfDB	200 + 50	USD	40	0.25% per annum (AfDB) 0.65% (WB)	5 year disbursement period. 10 years grace with one-time management fee of 0.25% = USD 625,000.	WB 2011.10.03 Project Appraisal Document (Eskom Renewables Support Project).
IBRD	195	USD	20			
AfDB	220	USD	20			
AFD	130	EUR	20			
KfW	100	EUR	20			
EIB	100	EUR	20			

CTF Loan: A US Dollar Loan for a maturity of 40 years, 5-year disbursement period, 10 years Grace with a interest charge of 0.25 percent per annum on disbursed amounts and a one-time upfront fee of 0.25 percent of the Loan Amount.

* Since inception of the loan

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