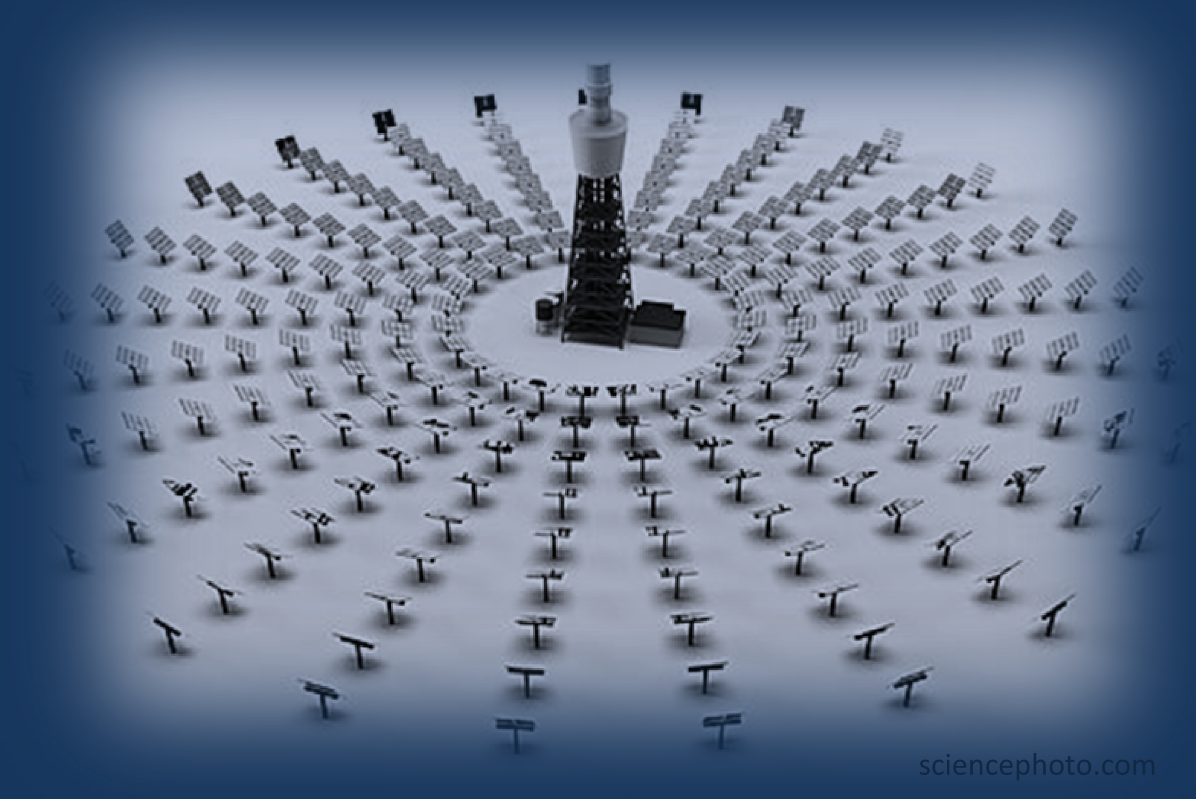

MACRO-ECONOMIC IMPACT ASSESSMENT OF THE CONCENTRATED SOLAR POWER PLANT (SOLAR 1) NEAR UPINGTON, NORTHERN CAPE

Final
December 2011

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ABBREVIATIONS

ACSA	Airports Company South Africa
CAGR	Compounded Annual Growth Rate
CAPEX	Construction Expenditure
CSP	Concentrated Solar Power
DM	District Municipality
EPC	Engineering, Procurement and Construction
FTE	Full-Time Equivalent
GDP-R	Gross Domestic Product per Region
GHG	Green House Gas
GWh	Gigawatt-hours
HTF	Heat Transfer Fluid
IDP	Integrated Development Plan
IPAP	Industrial Policy Action Plan
IPP	Independent Power Producer
IRP	Integrated Resource Plan
KW	Kilowatt
KWh	Kilowatt-hours
LED	Local Economic Development
LFS	Labour Force Survey
LM	Local Municipality
Mtoe	Million tons oil equivalent
MW	Megawatt
n.e.c.	not elsewhere classified
NDP	National Development Plan
NERSA	National energy Regulator of South Africa

NGPF	New Growth Path Framework
NOCCI	Northern Cape Chamber of Commerce and Industry
NREL	National Renewable Energy Laboratory
OPEX	Operating Expenditure
PV	Photovoltaic
R'ml	Rand million
SAM	Social Accounting Matrix
SMME	Small, Medium, and Micro Enterprise

CHAPTER 1. INTRODUCTION

Urban-Econ Development Economists were appointed by Eskom Holdings SOC Limited to undertake a macro-economic impact study for the Concentrated Solar Power Plant (further referred to as Solar 1) planned to be established near Upington, the Northern Cape Province. This report presents the results of the study.

1.1 Scope of the study

The scope of work for the study includes ***conducting a macro-economic impact assessment of the proposed facility near Upington with the purpose of identifying the extent to which the project will stimulate the development and contribute to the economic growth in the country and in the region where it is to be established***.

The objectives of the study include:

- Determine the extent to which the expenditure during construction and operations of the project can be localised, i.e. retained within South Africa's boundaries
- Estimate the degree to which the localisation effects can be concentrated within the local economy where the project is planned to be established
- Undertake an economic modelling exercise to determine the effects of the localised expenditure on the national, provincial and local economies
- Interpret the results of the modelling exercise in terms of the following:
    - Impact on production of the existing firms
    - Impact on infrastructure and resources in the region
    - Impact on employment
    - Impact on social lives of communities
    - Changes in the competitiveness levels
    - Changes in the size of affected economies

1.2 Understanding economic impact

Prior the introduction of the methodology employed in the study, it is important to explain the concept of an economic impact.

Economic impact refers to the effect on the level of economic activity, the welfare of households in and the standard of living of communities from a given area as a result of some form of external intervention in the economy. The intervention can be in the form of new investment in infrastructure, new development, adoption of a new policy or services, expansion of the current operations, closure/decommissioning of a facility, etc. Economic impact stimulated by the intervention can be positive or negative depending on the activity itself. It usually includes changes in the number of jobs, business sales, value-added, wealth, and disposable income. All of the above are measures of the level of improvement in economic well-being of communities, which is generally the primary purpose of any economic intervention.

Economic interventions do not only create direct changes in economic activities, but have spill over effects on other economic agents. As illustrated in Figure 1-1, three types of economic impacts are generally assessed:

- The direct effects are generated when new business creates new jobs and purchases goods and services to operate the new facility. Direct impact results in an increase in job creation, production, business sales, and household income.
- The indirect effects occur when the suppliers of goods and services to the new businesses experience larger markets and the potential to expand. Indirect impacts result in an increase in job creation, value added, and household income.
- The induced effects represent further shifts in spending on food, clothing, shelter and other consumer goods and services as a consequence of the change in workers' income and payroll of directly and indirectly affected businesses. This leads to further business growth or decline throughout the local economy.

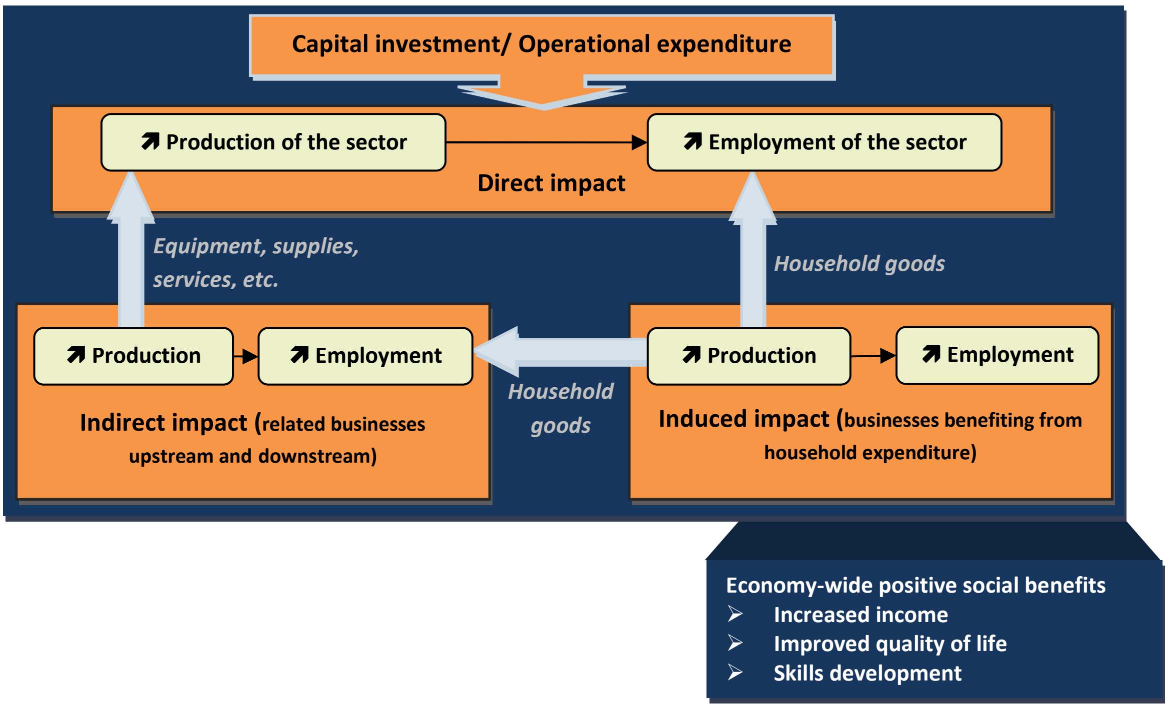


Figure 1-1: Impact of capital investment/operational expenditure

Economic impacts can be viewed in terms of their duration, or the stage of the project's lifecycle that is being analysed. Generally two phases are subjected to the economic impact assessment - the construction phase and the operational phase. Most of the economic impacts that occur take place during the construction phase and have a temporary effect. On the other hand, the operational phase of the project usually takes place over a long-term;

hence, the economic impacts that occur during this stage are generally of a sustainable nature.

1.3 Methodology

The methodology employed in conducting the study comprised of four main steps, i.e. data gathering, data analysis, modelling, and interpretation (Figure 1-2).

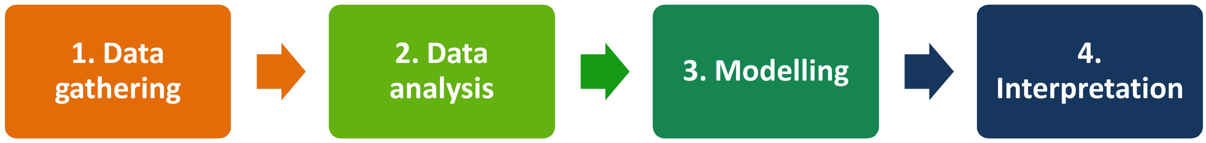


Figure 1-2: Methodology

The following paragraphs briefly describe each of the steps.

Step 1: Data gathering

Impact assessment requires the knowledge of the policy environment, projects expenditure during both the construction and operational phases, and knowledge of socio-economic indicators of economies that will be affected by the proposed project. Gathering of the above-mentioned data followed the next approach:

- Understanding of the **policy environment** within which the project is to be established assist in determining the important of the project and its alignment with the national, provincial and local government objectives. The following documents were sourced and reviewed to put the project into the policy perspective:
    - New Growth Path Framework (NGPF) (2010)
    - Industrial Policy Action Plan (IPAP) 2011-2014
    - The White Paper on Renewable Energy
    - Integrated Resource Plan (IRP) Promulgated on 6 May 2011
    - The Northern Cape Growth and Development Strategy
- **Information on the construction and operational phase expenditure** was sourced from Eskom and was augmented with information collected during the interview with Eskom's representatives and in various reports, including Fichtner (2010) and the National Renewable Energy Laboratory (NREL) (2006) documents. These figures present estimates and could change in the future, however for the purpose of the study they were deemed to be sufficient. Each expenditure item was presented in terms of local and foreign expenditure, i.e. illustrating the amount of money that will be spent within the country on procuring materials or services required for the construction or operation of the proposed facility. The breakdown of expenditure in terms of expenditure in South Africa and expenditure on imported goods was done in consultation with the representatives from Eskom. These data were confirmed and amended on the basis of the interview conducted with the CSIR and on the basis of secondary data collected from various sources. In addition, the interviews conducted

with local authorities and businesses in the municipality, where the project is to be established, assisted in determining the extent to which local expenditure can be concentrated within that municipality as opposed to other parts of South Africa. This information was important to determine the extent to which the local economy would benefit from the project.

- In order to understand the significance and extent to which the project can change the affected economies, results of the modelling exercise are interpreted in the context of these economies. This in turn requires understanding of **the size, dynamics, and structure of the economies** within which the project's impact are to be spread. For this purpose, the information regarding the affected economies was gathered from the secondary and primary data sources, including:
    - Secondary data sources:
        - Quantec database (1995-2010)
        - StatsSA Labour Force Survey (LFS)
        - StatsSA Supply and Use tables (2005)
        - Siyanda DM: Integrated Development Plan (IDP) DP 2010-2011 and Integrated Economic Development Plan (IEDP) 2006
        - Kai !Garib LM: IDP 2010
        - Kara Hais LM: IDP 2007-2012 and LED 2010
    - Primary data sources:
        - Interview with the district Manager for Siyanda District Municipality (DM) from the Northern Cape Province's Department of Economic Development and Tourism (Mr Desmond Maganga)
        - Interview with the Siyanda DM' Technical Manager (Mr Jakes Nakoo)
        - Interview with the //Khara Hais Local Municipality's Technical Manager and Local Economic Development (LED) officer
        - Interview with the Northern Cape Chamber of commerce and Industry (NOCCI) Upington
        - Interview with the Black Business Forum in Upington
        - Telephonic interview with the LED manager at the Kai !Garib LM
        - Discussions with prominent local businesses, including Upington International Airport, McDonalds Transport, Kobus Duvenhage Building Contractors, and Idada Trading.

Step 2: Data analysis

Data analysis involves the processing of information gathered during the previous step and presenting its results in terms of selected economic variables. With respect to information regarding the project the data is reviewed, collated and presented as input into the modelling exercise. Information regarding the policy environment and economies is analysed and presented as the baseline data.

Step 3: Modelling

The modelling exercise makes use of two economic models developed on the basis of the South Africa's Social Accounting Matrix (SAM) and the Northern Cape Province's SAM updated to 2011 figures. The SAM is a comprehensive, economy-wide database that contains information about the flow of resources that takes place between the different economic agents in this case in the provincial economy. The selection of two models to be used in the assessment is attributed to the expected spatial distribution of procurement during both the construction and operational phases. It is expected that most of the local inputs required for the project will be sourced from outside the Northern Cape Province, which justifies the use of the national SAM. Some expenditure during construction and most of spending during operations, though, are assumed to be retained in the Northern Cape Province; thus the use of both SAMs – for South Africa and the Northern Cape.

The following assumptions were used with respect to the economic model and the modelling exercise:

- The Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) figures reflect the real situation accurately enough for the purpose of the impact assessment
- The impact assessment assumes that the proposed development concept is financially viable, and both, private and public companies will be involved in its realisation
- Production activities in the national and provincial economies are grouped in homogeneous sectors
- The mutual interdependence of sectors is expressed in meaningful input factors
- Each sector's inputs are a function of the specific sector's production, comparative advantage, and location
- The production by different sectors is equal to the sum of the production of separate sectors
- No structural changes in the national and provincial economies are experienced during the analysed period.

The results of the modelling exercise were provided in constant 2011 prices to ensure the compatibility of this data with the baseline data, which is also presented in 2011 figures where applicable.

Step 4: Interpretation

The results of the modelling exercise were interpreted against the current status of the analysed economies. The analysis included the interpretation of the project's alignment with respect to the current policy environment and its impact on production, employment, wealth, and livelihoods of affected economies and communities. Direct, indirect and induced effects were analysed with respect to categories of impacts where applicable.

CHAPTER 2. BACKGROUND TO THE PROJECT

2.1 Project overview

The proposed Solar 1 involves the construction and operation of a 100 MWe Concentrating Solar Power (CSP) facility that uses central receiver technology and includes a minimum of 9-hour storage capacity. The project is seen as a pilot project implemented by Eskom with the aim to demonstrate the technology and identify any challenges related to its deployment before the large-scale roll out is attempted by Eskom. The specific aspects that are the focus of the pilot project include, inter alia:

- Prove technology performance
- Exploit large scale energy storage options
- Confirm costs, build times, integration complexities and other aspects
- Confirm the ability of the technology under analysis to support coal for base load options
- Build skills in specialised areas such as Solar Energy Specialist
- Lower risks for future projects

Solar 1 is funded by Eskom through multi-lateral financing and is governed by the World Bank's procurement guidelines, policies, and procedures. The project is in direct alignment with Eskom's vision to "provide sustainable electricity solutions to grow the economy and improve the quality of life of people in South Africa and in the region", as outlined in Eskom's Integrated Report of 2011. The project also supports the following strategic objectives of Eskom, inter alia:

- Capacity expansion to ensure energy security through the New Build Programme
- Reducing the carbon footprint by diversifying its energy generation mix by, amongst others, employing renewable sources in generation of electricity

2.2 Description of project's components

The proposed Solar 1 will make use of central receiver technology and molten salt as both the heat transfer fluid (HTF) and storage medium. The schematic presentation of the entire system and its major components is provided in Figure 2-1. For the economic analysis purposes, the project is broken down in terms of seven major groups each being associated with either a separate system or activity. These are, inter alia:

- Project management
- Earthworks and civil works
- Building and structures
- Solar field
- Receiver, HTF and storage system
- Power Block
- Balance of the plant

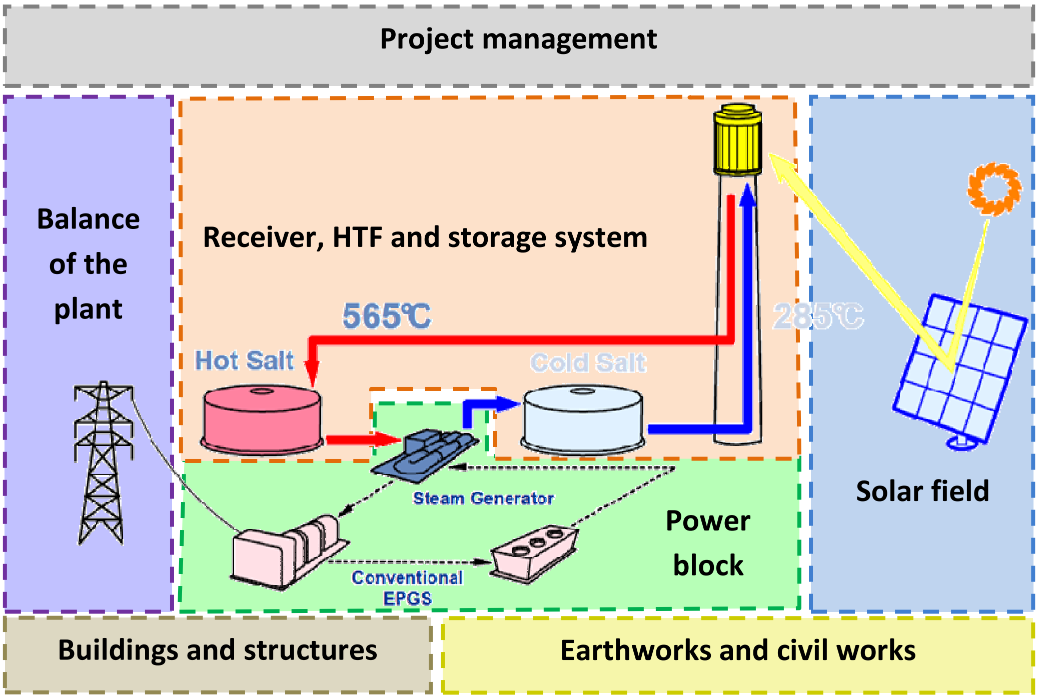


Figure 2-1: Components of the project (Source: Bohlweki Environmental, 2006)

The following table outlines the elements of each component of the project and provides a more detailed description thereof. It also highlights the type of industries that could be involved in production of various elements or in provision of services, which informs the focus of the baseline profiling.

Table 2-1: Description of key elements

Key elements	Notes
Solar field	
Mirrors	• About 10 000 mirrors is required to ensure 9-hour storage capacity • Low-iron sand is required since "white glass" as opposed to "green glass" is used • Mirrors are flat and need to be highly precise to minimise possible reflection losses • Although mirrors might be plant-specific, they can be manufactured by industries producing glass for the automotive industry (Manufacture of glass and glass products)
Metal support structures	• Can be made of steel or aluminium • Need to be designed specifically for the type of heliostat to be used • Produced by companies involved in manufacturing of structural metal products
Drivers, tracking system, etc.	• Require know-how • Drivers are designed for the specific metal support structure developed • Manufactured by companies in the following sectors ➢ Manufacturing of electricity distribution and control apparatus ➢ Manufacturing of electronic valves and tubes and other electronic components ➢ Manufacturing of electric motors, generators and transformers
Receiver, HTF and storage system	

Key elements	Notes
Receiver	• About 20 m high • Highly specialised coating required • Very specific to the CSP facility • Comprises of receiver tube panels, receiver headers, interconnecting piping, riser and downcomer piping, receiver panel support structure, receiver shield, vent and drain system, heat tracing and insulation • Requires substantial R&D investment to design, test and commercialise • Various manufacturing companies can be involved to supply certain elements, but the system is put together by the company that developed it
Tower	• About 200 m high • Involves a concrete tower shell design and includes a lift, ladders, and landing • Cement, steel and steel structures are the main material inputs • Inputs are procured from non-metallic mineral products industry, the basic iron and steel industry, and the structural metal products industry • Construction of tower does not differ significantly from the construction of other similar structures using concrete and steel
Molten Salt	• About 30 000 tons required to ensure over 9-hour storage capacity • Eutectic mixture of sodium nitrate and potassium nitrate, as it matches the operating temperatures of modern Rankine cycles • Molten salt is used • Sodium nitrate, which is also an integral input for production of potassium nitrate, is produced from caliche ore • Produced by companies specialising in such a medium and that form part of the chemical industry
Storage tanks	• About 20 m in diameter • Produced using carbon steel for a cold tank and stainless steel for a hot tank • Requires proper insulation • Produced by companies involved in manufacturing of tanks, reservoirs and containers, as well as manufacturers of non-metallic mineral products and refractory ceramic products
Hydraulic pumps	• Needs to consider experience with molten salt and its specific qualities • Specialised pumps that need to withstand high temperatures • Produced by companies specialising in high temperature pumps, which in turn form part of the manufacturing of pumps, compressors, taps and valves sector
HTF pipes	• Needs to consider experience with molten salt and its specific qualities • Pipe routing is not standard - specialised knowledge is required • Produced by companies with experience and knowledge in high temperature pipe manufacturing and piping engineering, which in turn form part of the manufacturing of basic iron and steel sector and treatment and coating of metals; general mechanical engineering on a fee or contract basis
Power block	
Steam Turbine	• This is not unique to the CSP and is used in conventional power plants and other industries, but technically steam turbines are the most complex and difficult parts of the CSP plant • Produced by companies with long-term experience in the field • Forms part of the manufacturing of engines and turbines sector
Condenser, feed	• These are also not unique to the CSP and not even to the power plants only

Key elements	Notes
heaters, pumps, pipes, vessels, electrical and instrumentation	• Industries that supply these inputs include: ➢ Manufacturing of pumps, compressors, taps and valves ➢ Manufacturing of electronic valves and tubes and other electronic ➢ Manufacturing of other electrical equipment n.e.c. ➢ Manufacturing of steam generators, except central heating hot water boilers ➢ Treatment and coating of metals; general mechanical engineering on a fee or contract basis ➢ Manufacturing of medical appliances and instruments and appliances for measuring, checking, testing, navigating and for other purposes, except optical instruments
Balance of the plant	
Piping, cabling, electrical equipment, compressed air system, cooling system water treatment, instrumentation, etc.	• Components are used in various systems and are not unique to the CSP technology • Produced by companies with the following sectors: ➢ Manufacturing of pumps, compressors, taps and valves ➢ Manufacturing of electric motors, generators and transformers ➢ Manufacturing of insulated wire and cable ➢ Manufacturing of electricity distribution and control apparatus ➢ Manufacturing of other electrical equipment n.e.c. ➢ Treatment and coating of metals; general mechanical engineering on a fee or contract basis ➢ Manufacturing of medical appliances and instruments and appliances for measuring, checking, testing, navigating and for other purposes, except optical instruments
Site works and infrastructure	
Roads, foundations, site works	• General civil construction activities which are not unique to the CSP facility • Can be done by companies in the non-building construction sector with inputs largely procured from the basic iron and steel industry (steel rods for foundations), the quarrying sector, and the non-metallic minerals products industry (aggregates and cement largely for roads and foundations)
Building structures	
Control room, admin building, security office, and visitor's centre	• Requires general building materials, including bricks, cement, plaster, tiles, etc. • Can be completed by construction companies and inputs sourced largely from the non-metallic minerals products industry, the basic iron and steel industry, and the structural steel industry
Heliostat assembly facility	• Largely made of the steel structure and bricks • Can be built by the construction company with components being procured from manufactures of structural steel products, bricks, and non-metallic-mineral products
Fence	• Largely comprises of basic iron and steel products
Parking area	• Depending on the cover, can require steel structures, cement, cement products, tar and other materials • Can be done by a general contractor with components being procured from various non-metallic and structural steel products industries
Project management	
Design and management	• Requires knowledge of the technology and knowledge in construction • Responsibilities can be split between different companies – i.e. developer and

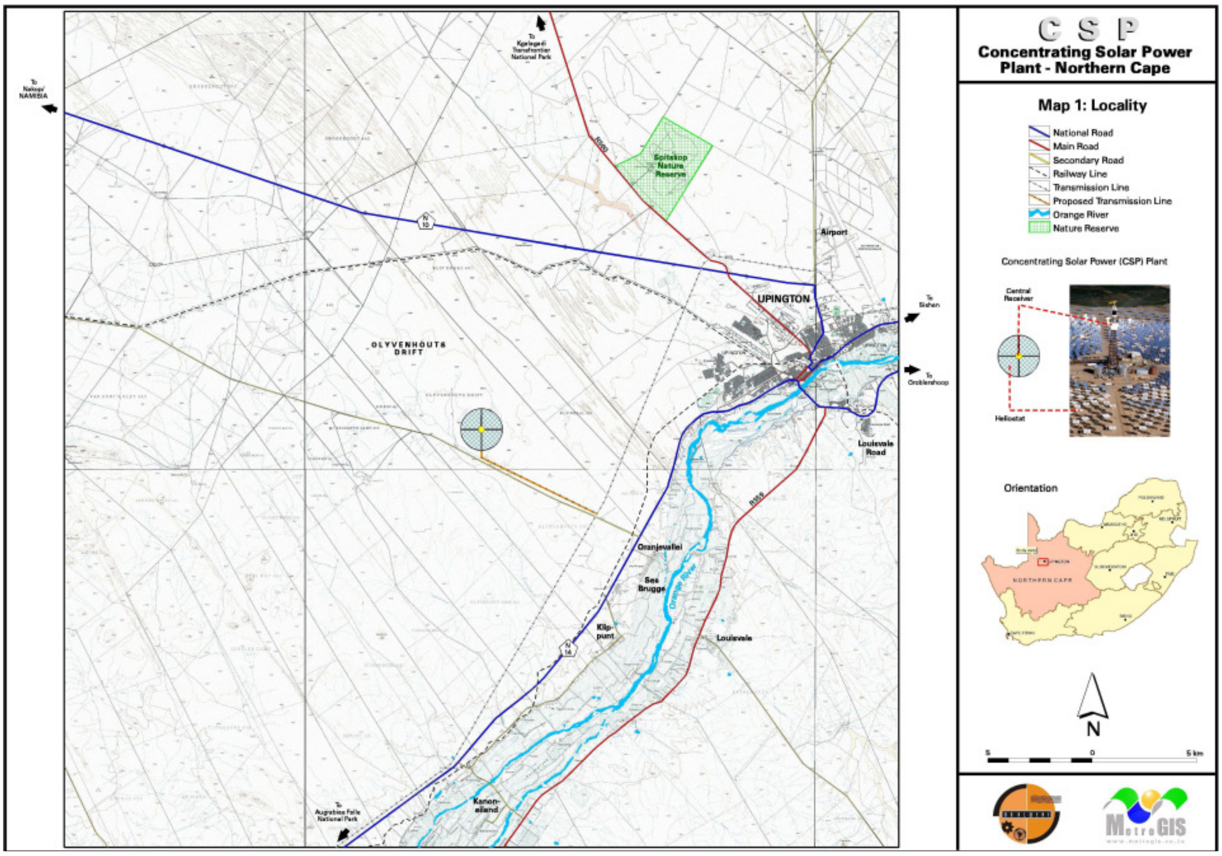
Key elements	Notes
	Engineering, Procumbent, and Construction (EPC) contractor

Sources: Fichtner, 2010; The World Bank, 2011; IEA, 2011; NREL, 2006; interviews with Eskom and CSIR held during the study, StatsSA, 1993

Based on the information presented in the table above, the establishment of the CSP facility using central receiver and molten salt technologies requires inputs from a wide range of industries. These largely include industries operating in mining and quarrying, manufacturing of non-metallic mineral products, manufacturing of chemicals and chemical products, manufactures of basic metals and fabricated products, and manufacturing of machinery and equipment.

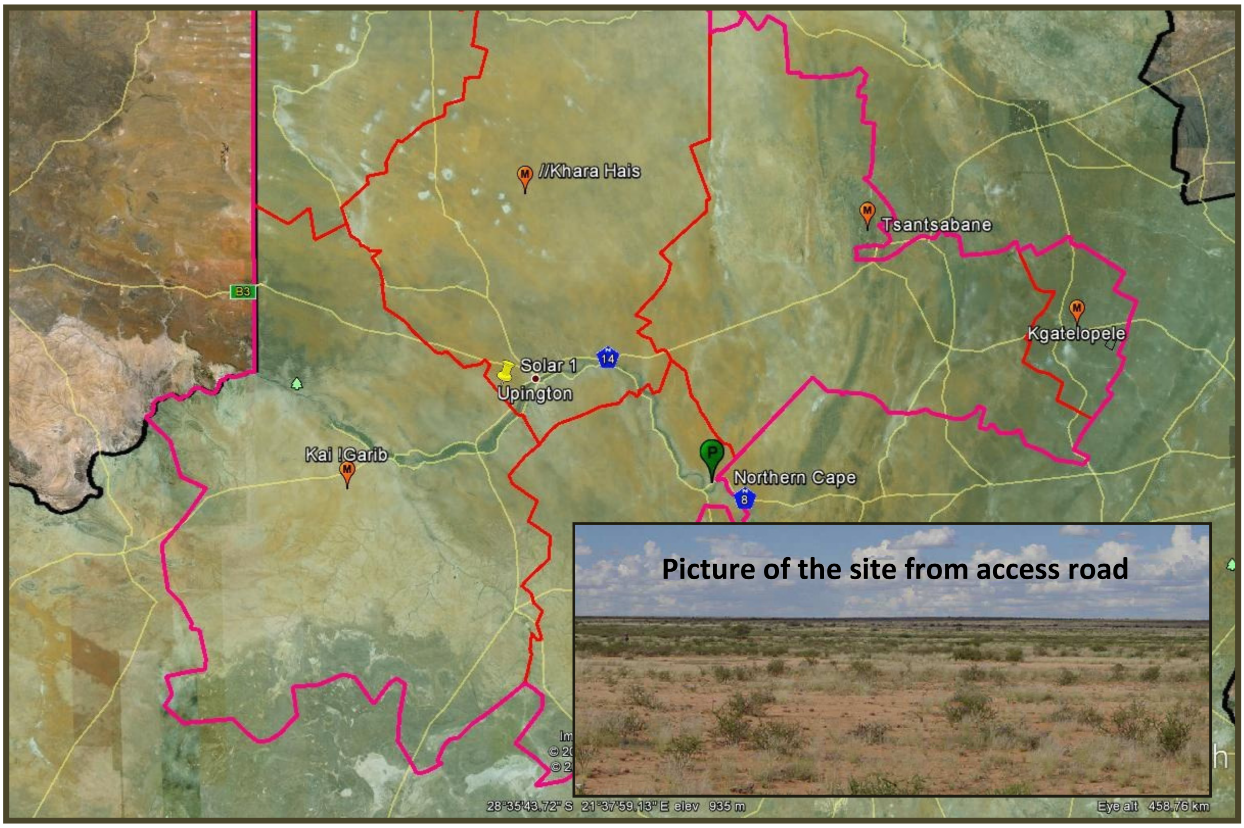
2.3 Project's location and study area delineation

The proposed Solar 1 is to be located about 15 kilometres west of Upington on the Farm Olyvenhouts Drift. The south-eastern part of the farm borders on the Orange River, and is used as agricultural land cultivated with grapes. The farm is also traversed by the N14 highway. There are a few settlements in close proximity to the farm, including Oranjevallei, Klippunt and the small informal settlement of Kalksloot. The road to Lutzputs crosses diagonally over the farm (refer to Map 1-1).



Map 2-1: Locality *Source: MetroGIS, 2007)*

In the context of the municipal demarcation, the site is located in the //Khara Hais Local Municipality (LM), with Upington being the major town in the area. The site is very close to the boundary with the Kai !Garib LM that is located to the south-west of //Khara Hais. Both of these municipalities form part of the Siyanda DM, which in turn is located in the Northern Cape Province.



Map 2-2: Site location within the Northern Cape Province *(Source: www.demarcation.org.za; Google Earth Map, 2011; MetroGIS, 2007)*

Study area delineation depends on the type of economic activity that is being analysed and the perceived spread of economic impacts that are expected to be generated from the project during both construction and operation. The municipal area where the site is located is likely to experience some direct, indirect and induced impacts resulting from the activities on site. However, it is highly unlikely that the local economy can be sufficiently diversified to supply all materials and services and support construction and operational activities from start to finish. Thus economic impacts tend to spread beyond the municipal boundaries and spread throughout the entire national economy.

The study area's delineation is usually done in terms of three levels – primary, secondary and tertiary. From an economic impact perspective, the primary study area refers to the locality where the immediate economic effects of the proposed activity will be observed. This is usually defined considering the actual location of the proposed project, proximity to skilled and unskilled labour, and juxtaposition relative to suppliers. The primary study area is usually relatively small and includes administrative units from where the majority of labour for the proposed project will be supplied and where some parts of the capital and operational budgets will be spent, such as a city, town or local municipality depending on data availability. The secondary study area is generally far greater than the primary study area. It usually has a relatively diversified economy, which is why it is also characterised as an area where a significant portion of the domestic expenditure on the project will be retained. The third tier of a delineated study area is the tertiary study area. From an economic impact perspective, it includes all impacts that would be derived from the project's domestic expenditure.

Given the location of the proposed project outlined earlier in the chapter, the following study areas for the purpose of this study are distinguished:

- primary study area includes the //Khara Hais LM
- secondary study areas include the Siyanda DM and the Northern Cape
- tertiary study area is South Africa

CHAPTER 3. BASELINE PROFILING

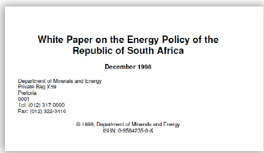
The purpose of this chapter is twofold. Firstly, it is to develop a clear understanding of the policy environment that shapes the development of the green economy in the country. This would assist in interpreting the projects strategic importance. And secondly, it is to set a baseline for interpretation of economic impacts that are expected to take place during both the construction and operational phases.

3.1 Policy environment

Climate change is a major global concern and it is believed that the main cause thereof is emission of carbon dioxide (i.e.$CO_{2)}$ in the atmosphere (CSP Today, 2008; Union of Concerned Scientists, 2010). Such carbon overload is a result of burning of fossil fuels such as coal, oil and gas and the cutting down of forests. Combustion of fossil fuels for energy generation is considered to be the biggest contributor to the increase in carbon dioxide in the atmosphere (CSP Today, 2008). Moreover, reliance on fossil fuel puts energy security in jeopardy and its fluctuations in price reduces the competitiveness of economies. As a result, many countries throughout the world have emphasised the importance of growing energy generation capacity using clean and renewable energy sources, such as wind, solar, biomass, geothermal, and hydro.

South Africa recognised the potential detrimental impacts of climate change on its people and sustainability. Importantly, the country is both the contributor to global warming and the potential victim of climate change (Department of Environmental Affairs, 2010). More than 80% of all greenhouse gas emissions generated by the country are attributed to the energy sector that is reliant on coal (Department of Environmental Affairs, 2010). Furthermore, under conservative emission scenario, the water temperature at coastal areas could rise by 1-2^{o}C and in land by 2-3^{o}C by the mid of this century (Department of Environmental Affairs, 2010). This could have a detrimental impact on food security and living conditions of people throughout the country. Furthermore, generation of electricity using coal is water intensive; and in a country that is already water-stressed the rise in temperature would decrease water availability overall, which will put energy security in greater jeopardy.

In light of the above, combating climate change became a prominent focus of the national government. It is also seen as a means to developing the country's economy and reducing poverty levels. All of the above is iterated in the following strategic documents:


White Paper on the Energy Policy of the Republic of South Africa

December 1998

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Pretoria
0001
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Fax: (012) 322-3416

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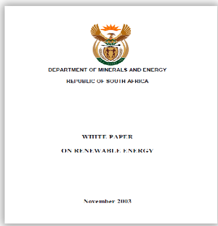
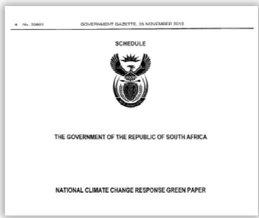
The White Paper on Energy Policy (1998) stated the need to improve the energy security in the country by means of expanding the energy supply options. This implies the increase in the use of renewable energy sources and encouraging new entries into the generation market.


DEPARTMENT OF MINERALS AND ENERGY
REPUBLIC OF SOUTH AFRICA
WHITE PAPER
ON RENEWABLE ENERGY
November 2003

The White Paper on Renewable Energy (2003) sets a target of generating 10 000 GWh from renewable energy sources by 2013, which is equivalent to two units of a combined coal power plant each with a capacity of 660 MW. The energy generated should come primarily from biomass, wind, solar, and small-scale hydro. It is to be utilised for power generation and non-electric technologies such as solar water heating systems and bio-fuels.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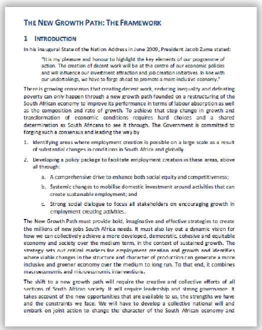
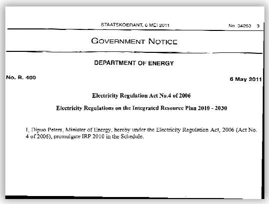
THE GOVERNMENT OF THE REPUBLIC OF SOUTH AFRICA
NATIONAL CLIMATE CHANGE RESPONSE GREEN PAPER

National Climate Change Response Green Paper (DEA, 2010) focuses on making a fair contribution towards stabilisation of greenhouse gas emissions and adapting and managing climate change impacts. The Paper proposes a number of approaches of dealing with climate change impacts with respect to selected sectors. Energy, in this context, is considered to be one of the key sectors that provides for possible mitigations to address climate changes. Some of the responses proposed to be implemented include, inter alia:

- Diversify the energy mix
- Use market-based measures, such as carbon tax, to motivate and drive diversification of the energy mix
- Establish a business environment for successful development of renewable energy manufacturing industry in the country
- Design and roll out ambitious Research and Development Projects aimed, amongst others, at diversifying the energy mix
- Review and scale up the 2013 target of generating 10 000 GWh of renewable energy


THE NEW GROWTH PATH: THE FRAMEWORK
1 INTRODUCTION

The New Growth Path Framework (2010) is the government's programme of action that focuses firstly on the creation of decent employment opportunities through the support of labour-intensive sectors and secondly on ensuring long-term growth through the support of more advanced industries. As a starting point, employment creation is planned to be stimulated in a few sectors including the green economy sector. Government plans to create 300 000 employment opportunities in the green economy alone by 2020, more than two thirds of which is intended to be created in construction, operation and maintenance of new environmentally friendly infrastructure.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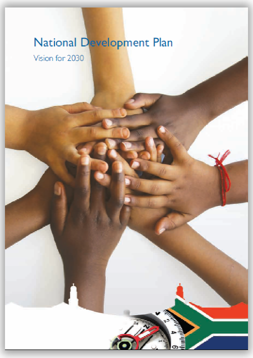
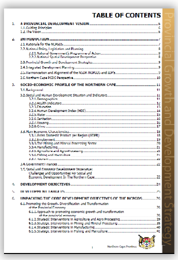
GOVERNMENT NOTICE
DEPARTMENT OF ENERGY
No. R. 400 6 May 2011
Electricity Regulation Act No.4 of 2006
Electricity Regulations on the Integrated Resource Plan 2010 - 2030
I, Dipuo Peters, Minister of Energy, hereby under the Electricity Regulation Act, 2006 (Act No. 4 of 2006), promulgate IRP 2010 in the Schedule.

The Integrated Resource Plan 2010-2030 (6 May 2011) projected that an additional capacity of 56 539 MW will be required to support the country's economic development and ensure adequate reserves over the next twenty years. The required expansion is more than two times the size of the existing capacity of the system. A significant component of the above-mentioned plan is, amongst others, the expansion of the use of renewable energy sources to reduce carbon emissions involved in generating electricity. Overall, the proposed plan implies the establishment, amongst others, of 1 200 MW_e of renewable energy generated from CSP in the next twenty years.



National Development Plan (NDP): Vision 2030 was formulated by the National Planning commission and released on 11 November 2011. The NDP proposes to create 11 million jobs and grow the economy at an average rate of 5.4% per annum by 2030 and ensure that half of the future new generation capacity comes from the renewable energy sources. It recognises, amongst other, the importance of the transition to low-carbon economy in achieving its employment creation and inequality eradication targets. As such, the NDP suggests the following:

- Support carbon budgeting
- Establish an economy-wide price for carbon by 2030 complemented by energy efficiency and demand management interventions
- Set a target 5 million solar water heaters by 2030
- Implementing zero emission building standards that promote energy efficiency
- Simplify regulatory regime to encourage renewable energy, regional hydroelectric initiative and independent power producers (IPPs)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The Northern Cape Provincial Growth and Development Strategy (2008) identified sustainable utilisation of natural resource as one of the cross-cutting issues to be addressed to facilitate growth, diversification, and transformation of the provincial economy. In this context the main principle remains to be the conversion of non-renewable energy to renewable energy in the province. The development of new sources of energy making use of local endowments is seen as the means to ensure availability of inexpensive energy in the future.

The review of the policy environment suggests that utilisation of renewable energy sources in the country is considered to be an integral means of reducing carbon footprint of South Africa, diversifying the national economy, and reducing poverty.

3.2 Size of the analysed economies

Interpretation of economic impacts requires a sound understanding of the size of the economy and its dynamics in the past. A number of indicators exists that can describe the economy of a region or an area. The most common variable that is used for the analysis is the Gross Domestic Product per Region (GDP-R). It means the sum of value added created by all residents within a certain period of time, which is usually a year. The combination of GDP-R and population figures provides the assessment of the per capita GDP-R, which is useful in measuring the performance of one country over another and assessing a general standard of living of the people. Table 3-1 outlines the key economic data for the areas under analysis.

Table 3-1: Key economic indicators (2011)

Study area	Population	GVA, R'ml		CAGR (2000-2011)	Per capita GVA	
		Current prices	Constant 2005 prices		R, current prices	US$ (PPP)
South Africa	50 590 000	2 637 801	1 693 470	3.5%	52 141	9 801
Northern Cape	1 096 731	53 222	34 169	1.9%	48 528	9 122
Siyanda DM	247 611	11 081	7 114	2.9%	44 751	8 412
//Khara Hais LM	104 348	4 796	3 079	3.5%	45 961	8 639

Source: Quantec, 2009; StatsSA, 2011b, IMF, 2011

Note: PPP stands for the Purchasing Power Parity which represents an adjustment to the national currency to equate it to other country's purchasing power

South Africa South Africa encompasses a population of about 50.59 million people (StatsSA, 2011a). It is estimated that the size of the national economy is about R2 637.8 billion in current prices or R1 693.5 billion in constant 2005 prices (Urban-Econ's estimations based on Quantec and StatsSA data, 2011). Thus, the per capita GDP-R in South Africa was R52 141 in nominal terms, which is about US$9 801 considering a Purchasing Power Parity index of 5.32 (IMF, 2011). This is significantly greater than the average per capita GDP-R of US$2 382 in the Sub-Saharan countries, but four times smaller than the same measure amongst the advanced countries (IMF, 2011). This suggests that the standard of living in South Africa is generally far better than in the Sub-Saharan African countries, but still far worse than that of the advanced countries.

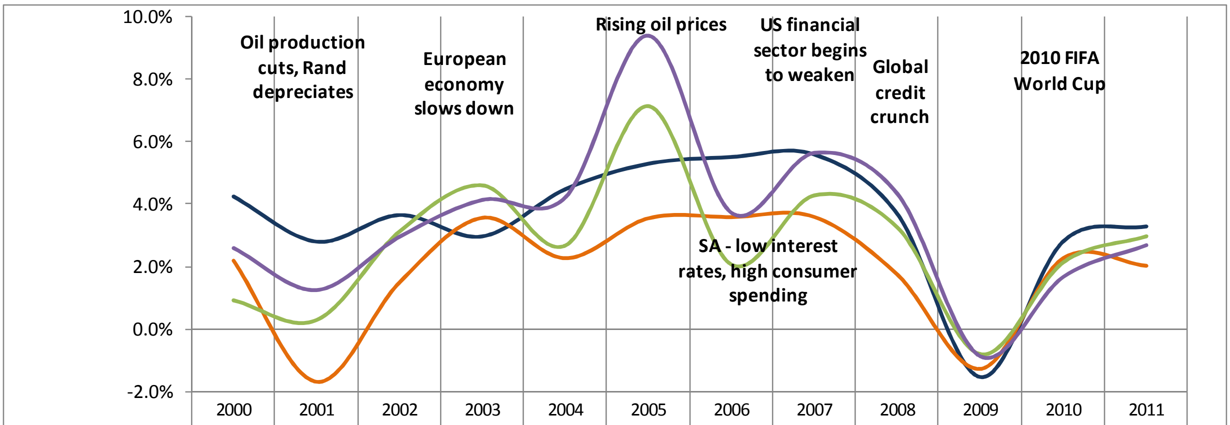
Northern Cape The Northern Cape Province has the smallest population amongst the nine provinces in the country; however it encompasses about 30% of the entire area of South Africa that makes it the biggest province in terms of landmass. The biggest economic centres in the province include Kimberley and Upington. In 2011, the provincial economy was valued at about R53 222 million in current prices, which accounted for 2% of the national economy. The per capita GDP-R of the province was slightly smaller than that of South Africa, which suggests that on average the standard of living in the Northern Cape was slightly worse than that of the country in general.

Siyanda DM The Siyanda DM is one of the five districts in the Northern Cape. In 2011, one out of five Rand was generated by the Siyanda economy in the province, making it the third largest district in the Northern Cape after the Frances Bard and Kgalagadi municipalities. The per capita GDP-R in the district is below that of the province and subsequently the country, which suggests that the general standard of living in the district is below the provincial and national average standard of living.

//Khara Hais The //Khara Hais LM is one of the seven municipal areas in Siyanda. In 2011, the //Khara Hais economy was valued at R4 796 million in current prices, which equated to about 43.3% of the district's economy making it the largest local economy in the entire Siyanda region. The per capita GDP-R in //Khara Hais was lower than that in the province, but higher than in the district in general. This suggests that on average, the standard of living in the primary study area is better than in the rest of the district.

3.3 Dynamics of the analysed economies

The trend at which the GDP-R has been changing in the past is also referred to as an economic growth indicator. It is a measure of both the performance of an area and the well-being of the citizens of an area. Faster economic growth than population growth is taken as an indicator of a healthy economy and an improvement in citizens' standard of living.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Africa	4.3%	2.8%	3.7%	3.0%	4.5%	5.3%	5.5%	5.6%	3.7%	-1.5%	2.8%	3.3%
Northern Cape	2.2%	-1.7%	1.5%	3.6%	2.3%	3.5%	3.6%	3.6%	1.7%	-1.3%	2.3%	2.0%
Siyanda DM	0.9%	0.3%	3.1%	4.6%	2.7%	7.1%	2.1%	4.3%	3.3%	-0.8%	2.1%	3.0%
//Khara Hais LM	2.6%	1.3%	3.0%	4.1%	4.2%	9.4%	3.7%	5.6%	4.3%	-0.9%	1.7%	2.7%

Figure 3-1: South Africa's economy trend versus global economy (2000-2011)

Source: Quantec, 2011; StatsSA, 2011b; IMF, 2011

South Africa Over the last ten years the country has been growing at a Compounded Annual Growth Rate (CAGR) of 3.5%, which was higher than that of the global economy (2.7%). As illustrated in Figure 3-1, the national economy' growth rate was on an upward trend up until 2007, after which the global recession negatively affected the situation in South Africa with global demand for national commodities and export items dwindling whilst local consumer expenditure significantly decreasing. In the years following the recession, the global and national economies grew albeit at a slow pace. StatsSA (2011b) estimated that during the first half of 2011, the national economy grew at 3.2%, which was slightly less than the estimated growth of the global economy. The recovery of the global economy from the aftermaths of 2007/2008 financial crisis will be slower than was previously expected. The current forecast for future national economy's growth ranges between 3.0% - 3.2% per annum, which was downscaled from about 3.4%-3.6%.

Northern Cape The provincial economy's CAGR over the last ten years was about half (1.9% pa) of the national growth rate (3.5% pa). This suggests that the composition of the provincial economy and its economic environment make the province more sensitive to the exogenous changes (as was seen in 2001) and does not allow it to capitalise on opportunities created within the national economy during the upward trends (as seen between 2003 and 2007). Given the above, it is expected that the provincial economy would also have far greater difficulty in recovering from the recessions than the national economy, which is shown in the diagram above.

Siyanda DM The economic dynamics of the district's economy are far more volatile and cyclical than that of the country and the province. Since 2000, the district's economy grew at a CAGR rate of 2.9%, which was higher than the provincial economy's CAGR. At the same time, though, the Siyanda DM experienced far better performance during 2003, 2004, and 2007 when the provincial economy was struggling. This suggests that the districts' economy is more resilient to changes in the economic environment than the province and that it is more capable in capitalising on growth opportunities than the province.

//Khara Hais The primary study area's economy shows greater performance than the provincial and district's economy. Since 2000, the CAGR of the //Khara Hais economy was 3.5%, which was on par with the national economy and which was greater than the economic growth rates of the province and the district. In the last decade, //Khara Hais experienced a greater economic growth than other study areas under review in 2005, 2007 and 2008. During these years agriculture, construction and manufacturing showed the best performance. In 2011, devastating floods occurred in the region that damaged some of the crop. Thus, the expected growth rate in //Khara Hais for this year could be lower than expected.

3.4 Labour force

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs. As such, employment and unemployment rates are important indicators of socio-economic well-being. The following paragraphs examine the study area's labour market from a number of angles, including the employment rate and sectoral employment patterns.

Information box: Unemployed as per official definition

Unemployed are people, who:

a) did not work during the seven days prior the interview
b) want to work and are available to start work within a week of the interview, and
c) have taken active steps to look for work or to start some form of self-employment in the four weeks prior to the interview.

The composition of the labour force in the primary study area, Siyanda DM, Northern Cape and the country as reported by the LFS is detailed in Table 3-2. Unfortunately, though, since the latest LFS does not report on the data for municipalities, information for the study areas is sourced from the Quantec database and represents 2009 figures. This allows for a comparison between the study areas.

Table 3-2: Labour force statistics (2009)

Indicators	South Africa	Northern Cape	Siyanda DM	//Khara Hais
Working age population	31 496 936	704 615	163 008	67 308
Non-EA	15 131 133	329 386	71 740	28 861
Labour Force	16 365 803	375 229	91 268	38 447
Employed	*12 260 902*	*271 688*	*68 166*	*29 196*
Unemployed	*4 104 901*	*103 541*	*23 101*	*9 252*
Unemployment rate	25.1%	27.6%	25.3%	24.1%
LF participation rate	52.0%	53.3%	56.0%	57.1%

Source: Quantec, 2011

South Africa In 2009, South Africa had about 31.5 million people within the working age population. Of these, about 15.1 million were non-economically active and 16.4 million formed part of the labour force. This means that the labour force participation rate in the country was 52.0%. The number of employed people in South Africa was about 12.3 million, leaving 4.1 million people or 25.1% of the labour force unemployed.

Northern Cape The Northern Cape accounted for 2.3% of the national working age population, or 704 615 people. In 2009, just over 53% of the provincial working age population participated in the economy or were economically active. These people encompassed a labour force, which was divided into 271 688 employed and 103 541 unemployed people, indicating a 27.6% unemployment rate in the province.

Siyanda DM The Siyanda DM had a bigger percentage of the working age population participating in the economic activities than that of the province and the country. In Siyanda, 56.0% of the working age population were economically active, with 25.3% of these people being unemployed.

//Khara Hais The primary study area had a working age population of 67 308 people with 57.1% of these comprising the labour force. The labour participation rate in the //Khara Hais LM was higher than in other study areas, which suggests that a greater share of people in the local municipality were not only employed but also positive about finding employment opportunities compared to the other areas under analysis. Of the total economically active population, 29 196 people were employed and 9 252 were unemployed. This means that in light of the labour force figure, the unemployment rate in the primary study area was 24.1%. This was lower than that in the secondary and tertiary study areas, but it was still significant as one out of four economically active persons was unemployed.

It should also be noted that employment trends in //Khara Hais are highly seasonal. Between October and April, the number of people employed in the local agriculture sector, the hospitality industry, and the transport sector tend to increase significantly. This is attributed to two key factors:

- The key factor is the grape picking season that runs between October and April, as the area is the prime producer of table grapes and raisins in the country. However, it appears that in many cases local farmers have to employ people from outside the local municipality to come and work on their farms, where they are also provided with accommodation. This means that some of the seasonal jobs created within the municipality are absorbed by migrant workers and not by local labour. It is though surprising that local farmers have to acquire labour from the outside of the area, given that every fourth economically active person in the //Khara Hais Municipality is unemployed. The exact reason for this is not known, but it could be speculated that it could be attributed to the wages that farmers are capable of paying and lower wages that workers from other municipalities are willing to accept.
- Another factor that tends to increase the seasonal aspect of employment opportunities in both municipalities includes the testing of prototype vehicles by the German Association of Automotive Industry during the months of October to March. Workers from various German automobile manufactures come to Upington and surrounding areas to test their vehicles in different parts of the municipality and its surrounding areas. This boosts the hospitality industry in the area, albeit for a limited number of months every year.

3.5 Structure of the economies

The structure of the economy provides valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector is also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy and its structure.

South Africa

South Africa's economy is a service economy with the tertiary sector accounting for two thirds of value added generated in the country. The country does not only serve its population but also provides services to citizens from neighbouring countries, which explains its relatively developed services industries. As indicated in Table 3-3, aside from the services sectors, the country has a prominent manufacturing sector that is largely comprised of the petroleum and chemicals products, basic metal products, and food and beverages industries. Since 2000, construction was the fastest growing sector in the country largely due to the substantial residential and office developments seen in the period between 2005 and 2007 and public investment in preparation for the 2010 FIFA World Cup. Above average growth rates over the last ten years have also been experienced by the transport and financial services industries, growth of which to a certain extent is also attributed to the developments in the property market and public investment trends mentioned above. The other six economic sectors grew at lower than average growth rates, with manufacturing showing a 2.3% CAGR.

The composition of the national economy with respect to employment_structure differs significantly from the economic structure. This is attributed to differences in skills profiles and productivity levels in these sectors. Nevertheless, the tertiary sectors still account for the majority of employment positions generated in the country. Seven out of ten people in South Africa work in the services industries. Manufacturing also contributes a notable share towards job creation; however, it employs roughly one out of ten people in the country. Since 2000, South Africa created just under 700 000 new employment positions. Although a significant number of jobs were lost in 2009 following a global financial crises, which reduced the overall net increase of the jobs created in the country in the last decade, creation of roughly 70 000 jobs per annum is still a very small rate. Given that the NGPF targets creation of additional five million jobs until 2020, significant public and private sectors' efforts will be required to achieve this target.

Table 3-3: Sectoral structure and employment composition of the national economy (2011)

Economic sector	Value added			Employment (formal and informal)		
	R'ml, current	% of total	CAGR 2000-2010	Number	% of total	Change 2000-2010
Agriculture	59 543	2.5%	1.7%	688 472	5.7%	539 307
Mining	230 402	9.6%	0.1%	549 892	4.6%	-776 886
Manufacturing	352 176	14.6%	2.3%	1 355 841	11.3%	134 480
Utilities	66 812	2.8%	1.8%	60 424	0.5%	-172 729
Construction	91 973	3.8%	8.3%	674 186	5.6%	6 416
Trade	335 561	13.9%	3.1%	2 654 525	22.0%	9 060
Transport	220 039	9.1%	5.0%	551 229	4.6%	285 026
Finance and business services	511 331	21.2%	5.9%	1 899 901	15.8%	102 860
Community and personal services	152 747	6.3%	3.1%	1 785 898	14.8%	434 838
Government services	386 351	16.1%	2.7%	1 821 118	15.1%	127 266
Total	**2 406 935**	**100.0%**	**3.5%**	**12 041 486**	**100.0%**	**689 638**

Source: Quantec, 2011

Northern Cape

The Northern Cape economy's structure differs from that of the country although the tertiary sector is still the biggest sector in the province; however, unlike in the South Africa's economy the primary sector plays a prominent role in the provincial economy with a contribution of over 41% to its GDP-R in nominal prices. The provincial primary sector largely comprises of the mining sector, which shows a relative dependency of the province on the demand for commodities mined within the Northern Cape such as diamonds, silver, zinc, manganese, and iron ore. Such a dependency and unfavourable global conditions were primarily the main reason behind lower growth rates in 2004 and 2005 and shrinking of the economy in 2001 and 2009. Overall, the size of the provincial mining sector has shrunk, which reduced the overall growth rate of the Northern Cape during the past decade (Table 3-4). Secondary indsutries are relatively small in the Northern Cape which suggests that limited beneficiation activities are taking place in the province and most of the commodities are being exported to other provinces or countries largely in raw or semi-processes state.

As far as employment composition is concerned, about two thirds of employment created in the province is provided by the tertiary sector. Mining, despite its large contribution to the province's GDP-R, and creates only one out of ten jobs in the Northern Cape. Since 2000, all sectors besides agriculture and manufacturing have created new employment opportunities. Agriculture, though, lost about half of its employment positions that were available in 2000, whilst manufacturing lost about a quarter of employment opportunities available the same year. Most of employment opportunities lost in the agricultural and manufacturing sectors over the years were semi-skilled and unskilled types of jobs. This means that the decline in employment in these two sectors mostly affected people with lower levels of employability and smaller chances of finding alternate job. Given that the same two sectors have shown a positive growth rate over the years, it can be speculated that the decline in the number of jobs was driven by, amongst others, the automation of certain processes.

Table 3-4: Sectoral structure and employment composition of the Northern Cape (2011)

Economic sector	Value added			Employment (formal and informal)		
	R'ml, current	% of total	CAGR 2000-2010	Number	% of total	Change 2000-2010
Agriculture	3 163	5.5%	3.0%	38 872	14.5%	-29 413
Mining	20 727	36.0%	-1.3%	27 406	10.2%	8 634
Manufacturing	1 672	2.9%	2.6%	9 911	3.7%	-3 836
Utilities	1 267	2.2%	-0.5%	1 458	0.5%	323
Construction	914	1.6%	5.4%	12 059	4.5%	-306
Trade	5 853	10.2%	2.5%	43 726	16.3%	8 695
Transport	4 652	8.1%	4.1%	8 449	3.1%	2 219
Finance and business services	6 386	11.1%	4.3%	24 134	9.0%	9 716
Community and personal services	5 167	9.0%	3.3%	39 044	14.5%	4 625
Government services	7 785	13.5%	2.6%	63 482	23.6%	22 548
Total	**57 587**	**100.0%**	**1.9%**	**268 541**	**100.0%**	**23 205**

Source: Quantec, 2011

Siyanda DM

The Siyanda economy comprises of 49% of the tertiary sectors, 41% of the primary sector and 10% of the secondary sector. This means that the economy is very dependent on the primary activities; however, unlike the province where the primary sector also contributes more than four out of ten Rand towards GDP-R, the Siyanda primary sector is more diversified and consists of prominent agricultural activities. Siyanda has a very well developed horticulture sector with table grapes, sultanas (for raisins), wine grapes, nuts, dates and other horticultural products being grown in the area. Mining activity in the district largely occurs in the local municipalities of Tsantsabane and Kgatelopele, where manganese, diamonds and raw materials (ash) for producing cement are found. However, other forms of mining can also be found in the area, such as salt mining. The fact that the local manufacturing sector is very small suggests that locally mined commodities and grown agricultural products do not undergo extensive processing and beneficiation within the district. Over the years, all sector showed a positive growth with agriculture, utilities, construction and trade showing above average growth rates.

With respect to the employment structure, agriculture followed by trade and government services is one of the top three sector-employers in the district. Agriculture, being the biggest employer in the area, has reduced the number of jobs offered since 2000, which had a detrimental impact on the entire economy. Despite the fact that the economy grew in size since 2000, the district has lost about 1 500 jobs since 2000. About 10 700 jobs were lost in the agricultural sector since 2000, about a thousand jobs in the manufacturing sector and about 500 jobs in the government sector. At the same time, though, mining and trade sectors experienced a notable growth in the number of employment positions they offer. This, coupled with other sectors' contribution towards job creation over the analysed period, significantly reduced the number of jobs that the economy lost in total.

Table 3-5: Sectoral structure and employment composition of the Siyanda DM (2011)

Economic sector	Value added			Employment (formal and informal)		
	R'ml, current	% of total	CAGR 2000-2010	Number	% of total	Change 2000-2010
Agriculture	1 466	12.8%	4.4%	18 480	28.0%	-10 696
Mining	3 215	28.1%	2.4%	4 966	7.5%	2 772
Manufacturing	522	4.6%	2.6%	2 743	4.2%	-988
Utilities	408	3.6%	5.0%	485	0.7%	261
Construction	210	1.8%	6.9%	3 474	5.3%	549
Trade	1 430	12.5%	3.2%	10 977	16.7%	2 843
Transport	1 093	9.6%	6.1%	2 149	3.3%	832
Finance and business services	989	8.6%	0.6%	4 090	6.2%	493
Community and personal services	866	7.6%	1.7%	7 810	11.9%	-445
Government services	1 238	10.8%	1.2%	10 722	16.3%	2 832
Total	**11 439**	**100.0%**	**2.9%**	**65 896**	**100.0%**	**(1 547)**

Source: Quantec, 2011

//Khara Hais

The //Khara Hais economy is largely a service economy with three quarters of its GDP-R being generated by the tertiary sectors. The municipality includes Upington, which hosts both district and local municipal offices. This, coupled with the fact that Upington is one of biggest towns in the Northern Cape with a number of both educational and health facilities, explains its relatively large community and government services sector. The development of its trade and business services sector is also related to the concentration of population in the area and economic activities in and around Upington. The transport sector in the municipality is represented by the Upington International Airport and a number of major transport companies that provide services to the agricultural and retail sector within //Khara Hais, as well as outside its borders. Amongst the primary and secondary sectors, agriculture is the most prominent economic activity. Since 2000, it also experienced the largest economic growth, followed by the utilities sector, construction and mining.

Most of the employment in //Khara Hais is created by the government services, trade and agriculture. These three sectors also notably increased the number of employment opportunities provided. The other sectors except for manufacturing also showed a positive change in employment. Overall, employment in the //Khara Hais LM increased by about a third since the beginning of the century, which is indicative of a vibrant and constantly growing economy.

Table 3-6: Sectoral structure and employment composition of the //Khara Hais LM (2011)

Economic sector	Value added			Employment (formal and informal)		
	R'ml, current	% of total	CAGR 2000-2010	Number	% of total	Change 2000-2010
Agriculture	384	8.7%	11.7%	4 617	15.9%	1 530
Mining	127	2.9%	5.2%	237	0.8%	157
Manufacturing	216	4.9%	2.3%	1 383	4.8%	-441
Utilities	291	6.6%	9.5%	320	1.1%	222
Construction	99	2.2%	7.3%	1 567	5.4%	305
Trade	879	19.8%	4.1%	6 979	24.0%	2 255
Transport	666	15.0%	4.7%	1 281	4.4%	397
Finance and business services	544	12.2%	0.0%	2 212	7.6%	70
Community and personal services	484	10.9%	3.0%	3 817	13.1%	446
Government services	750	16.9%	2.0%	6 637	22.8%	2 085
Total	**4 442**	**100.0%**	**3.6%**	**29 049**	**100.0%**	**7 027**

Source: Quantec, 2011

3.6 Income levels

Income distribution is one of the most important indicators of social welfare, as income is a primary means by which people are able to satisfy their basic needs such as food, clothing, shelter, health, services, etc. Changes in income inflict changes in the standard of living, more specifically: a positive change in income can assist individuals, households, communities and countries to improve the living standards.

There is a direct linkage between the household expenditure and economic growth. Increase in household expenditure means a greater demand for goods and services, which means an increase in production and positive change in the size of an economy. As has been seen in 2005-2006 in South Africa, robust increase in disposable income coupled with low interest rates in the country stimulated an increase in consumption by households, in particular durable and semi-durable goods, which in turn had a positive impact on the country's economy. Knowledge of the volume of the disposable income and the expenditure patterns of households, therefore, can provide vital intelligence with respect to the sectors that are most dependent on the household income and therefore would be most affected in the case of change in household income.

Table 3-7 shows income distribution in study areas as captured in the Community Survey 2007. More recent data, unfortunately, are not available, whilst historical information is not robust and reliable enough to escalate the latest figures and estimate the situation in 2011 with great confidence.

Table 3-7: Income distribution (2007)

Monthly income category	South Africa	Northern Cape	Siyanda DM	//Khara Hais
No income	8.2%	6.8%	4.9%	2.8%
R1 – R200	5.0%	3.5%	2.0%	1.6%
R201- R800	9.0%	7.9%	9.3%	6.1%
R801- R1 600	18.9%	20.2%	22.1%	14.6%
R1 601 - R3 200	19.1%	19.8%	19.6%	18.0%
R3 201 - R6 400	11.4%	13.2%	12.3%	14.4%
R6 401 - R12 800	7.6%	8.0%	6.8%	10.4%
R12 801 – R25 600	5.3%	4.7%	3.7%	5.1%
R25 601 – R51 200	2.8%	2.2%	1.7%	1.9%
R51 201 - R102 400	0.9%	0.6%	0.6%	0.8%
R102 401 - R204 800	0.3%	0.2%	0.1%	0.0%
More than R204 800	0.2%	0.2%	0.1%	0.0%
No response	11.1%	12.6%	16.8%	24.3%
TOTAL	**100%**	**100%**	**100%**	**100%**
Weighted monthly average (2011 prices)	**R8 602**	**R7 761**	**R6 690**	**R 8 225**

Source: Urban-Econ calculations based on Community Survey 2007, 2011

South Africa In South Africa, an average household earned about R8 602 per month. Most of the households earned in the range between R801 and R6 400 per month and eight out of 100 households did not receive any income at all.

Northern Cape The Northern Cape average household earned about R7 761 per month, which was notably lower than the average household income in the country. Although a smaller share of provincial households did not receive any income, a significantly greater percentage of households in the Northern Cape earned between R801 and R6 400 per month than in the country. This coupled with the fact that a smaller share of households in the province compared to South Africa were also very affluent explain the lower average income levels in the Northern Cape.

Siyanda DM An average household in Siyanda earns about 22% less than an average household in the country. This is largely due to the composition of the Siyanda economy that is dominated by the sectors with greater semi-skilled and unskilled employment requirements and subsequently relatively small salary packages, i.e. agriculture, mining, and trade.

//Khara Hais In the primary study area, the average household income was lower than that in the country but higher than that in the province. This means that an average household in the //Khara Hais LM was better off than an average household in the province or the district. //Khara Hais has the lowest percentage of households with no income. Furthermore, the most common range of income is slightly better than in other study areas.

CHAPTER 4. LOCALISATION OPPORTUNITIES

The focus of this chapter is to assist in determining the extent to which the construction and operational expenditure of the project can be localised, with a particular focus on distinguishing between the activities that can be procured within the local economy and the rest of the country. The chapter starts with the analysis of the state of maturity of the CSP technology with the purpose of comprehending the global market dynamics and identifying the components of the project that can be procured within economies where projects are established. It furthers zooms onto the analysis of capabilities of the selected national, provincial, and local sectors to supply necessary materials, equipment, and services for the establishment and operations of the facility.

4.1 Global and national CSP market trends

Renewable energy contribution

Renewable energy accounts for about 14% of the global demand for energy and is projected to remain at the same level, whilst the global actual demand increases by 60% (refer to Figure 4-1). The largest portion of renewable energy in 2002 was represented by biomass used largely for cooking and heating; however, it is expected that as the renewable energy technologies mature the renewable energy mix will undergo significant changes with wind, geothermal, and solar energy usage rapidly increasing.

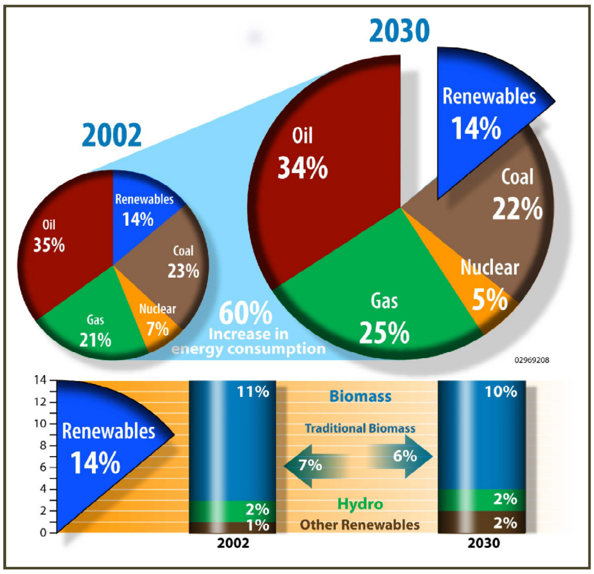


Figure 4-1: Global energy consumption (million tons fo oil equivalent, Mtoe) *(adopted from* Expert Group of Renewable Energy , 2005)

CSP technology

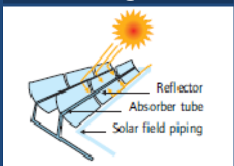
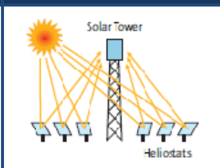
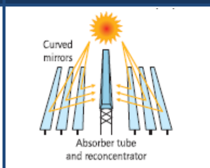
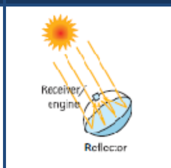
Concentrated Solar Power (CSP) systems represent a group of technologies that make use of solar energy to generate power. CSP concentrate energy from the sun's rays to heat a receiver to high temperatures; thereafter heat is transformed into a mechanical energy and then into electricity.

CSP is a proven technology with the first demonstration plants being established in 1981 in Spain, Italy and Japan (Fichtner, 2010; IEA, 2010). The first commercial plants began operation in California during the period between 1984 and 1991 supported by the introduction of federal and state tax incentives and mandatory long-term power purchasing contracts (IEA, 2010). In 2006, Spain under the government's feed-in tariffs also entered the market of commercial CSP projects. Compared to wind and Photovoltaic technologies, though, CSP can be considered a relatively emerging technology that equates to only a fraction of the total installed capacity of wind and PV systems, i.e. only about 0.03% (The World Bank, 2011). However, over a long-term CSP technologies have the potential to account for a much larger share of key renewable energy installed capacities due to its potential to provide base load and offer storage.

Types of CSP family technologies

Currently, four CSP technology families can be distinguished. These include parabolic troughs, linear Fresnel reflectors, solar towers, and parabolic dishes. As indicted in Table 4-1, the current global market is dominated by the family of parabolic troughs and it is expected that this technology will retain its majority share in the short to medium term. The other three families of CSP technologies represent a mere 6.6% of the current CSP operational capacity, but their share is expected to increase to 28% once the projects currently in the pipeline are completed. The share of the central receiver technology will then also increase from 5.3% of the current operational capacity to 11.5%.

Table 4-1: Current CSP projects in the world

CSP family technology	Parabolic troughs 	Central receiver 	Linear Fresnel reflector 	Parabolic dishes 	TOTAL
Operational	778	44	9	2	**833**
Under construction	1 400	17	30	1	**1 448**
Planning phase	8 144	1 603	134	2 247	**12 128**
Total	**10 322**	**1 664**	**173**	**2 250**	**14 409**

Source: IEA, 2010; The World Bank, 2011

SOUTH AFRICA'S CONTEXT

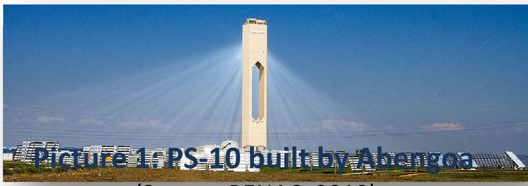
There are currently no CSP plants established in the country. However, a number of project developments are in the public domain, including (Fichtner, 2010):

- the proposed Eskom's CSP facilities (100 MW)
- the Solar Park to be established near Upington (1GW)
- the Exxaro Parabolic Trough project with a 200-250 MW
- Group Five/Kalahari project comprising of four 125-150 MW parabolic trough facilities

Much of the delay in establishing CSP facilities in the country could be attributed to the uncertainties regarding the procurement process and the Renewable Energy Feed-In Tariffs (REFIT). On 31 July 2011, though, government launched the programme to procure new renewable energy generation capacity by inviting potential developers to submit the proposal for financing, construction, and operation of wind, solar and other renewable energy projects. The first phase that assumes the facilities to be in operation by 2016 includes allocation of 3 725 MW of nameplate capacity, with CSP accounting for 200 MW thereof.

Central receiver and molten salt technologies

Central receiver technology involves a heliostat field, which comprises of multiple individually tracking plan mirrors, that concentrates direct solar irradiation onto a central receiver mounted at the top of a tower. Within that receiver, the HTF absorbs high radiation and converts it into thermal energy that can then be used in conventional power cycles, i.e. Runkine steam turbine or Brayton gas turbine.



Picture 1: PS-10 built by Abengoa

(Source: RENAC, 2010)

The first commercial central receiver power plant (PS-10) had a $10MW_e$ nameplate capacity and started operating in Spain in 2007, which was built by Abengoa Solar (Fichtner, 2010). Other plants using central receiver technology that have been in operation since then or are currently under construction include, inter alia:

Picture 2: PS-20 built by Abengoa

(Source: RENAC, 2010)

- PS-20 Plant with 20 MW_e located in Spain – in operation since 2009
- Sierra Sun Tower with 5 MW_e located in California, USA – in operation since 2009
- Solar Tower Julich with 1.5 MW_e located in Germany – in operation since 2008
- Solar Tress with 17 MW_e located in Spain – planned start of operation 2011
- Ivanpah 1-3 with 1 x 123 MW_e/ 2 x 133 MW_e located in USA – planned start of operation 2013

In addition to the above, about six CSP facilities making use of a central receiver are known to be in the pipeline globally, including Eskom's Solar 1. Their nameplate capacity varies between 92 MW_e and 150 MW_e and most of them are to be located in the United States of America.

CSP technology offers opportunity to store energy generated during the day for a short period of time and release it when it is mostly needed. Thermal storage systems are becoming an integral component of CSP plants, including those using central receivers. Ability to store energy allows such plants to generate electricity day and night; which in turn means that they can compete with convention coal-powered facilities.

Depending on the receiver concept, varying ***working fluids*** can be used to absorb heat generated at the central receiver point. These could be:

- Water, which was used by the first commercial central receiver facility and one of the two preferred HTF for the projects currently in the pipeline (The World Bank, 2011; Fichtner, 2010).

- Molten salt, which has been applied only at one of the central receiver projects in the past but which is planned to be used by half of the new projects that are currently in the pipeline (Fichtner, 2010).
- Atmospheric or pressurised air, which is currently only a pre-commercial concept (The World Bank, 2011; Fichtner, 2010)

All of the above suggests that the combination of central receiver and molten salt technologies is still in the emerging stage. This in turn suggests the following:

- The number of innovators and commercial projects on the market is limited.
- Knowledge is limited to the first few demonstration projects and is largely contained within a few companies
- Technology, and rather the entire CSP system, is not yet at the optimum level and significant potential exists in improving efficiency levels of various components
- Economies of scale in manufacturing of specific components are not yet achieved, thus the overall costs are relatively high but these will drop significantly in the future.

Global market composition of central receiver and molten salt technologies

The proposed facility, i.e. Solar 1, will make use of a central receiver tower and molten salt technologies to generate and absorb heat. These technologies though are only in the emerging stage, which means that new industries are being developed to produce them. Therefore, some suppliers and companies such as central receiver manufacturers represent new economic industries with limited existing capacities and will be entirely dependent on the growth of the renewable energy market and relative efficiencies of their technologies. CSP facility though makes use of many components that are deemed to be conventional in other applications. For example, a steam turbine generator is used in conventional coal-powered plants, whilst civil works is a component of every new construction activity. This means that many of the companies supplying inputs to the CSP facilities could be procured from industries with established production and manufacturing capabilities.

Table 4-2 provides an indication of the current global market structure in CSP facilities making use of central receiver and molten salt technologies with a purpose of identifying the possibility of establishing local procurement networks when developing a CSP facility making use of central receiver and molten salt technologies. Based on the information presented, the following can be concluded:

- The current market structures largely comprises of companies located in Germany, Spain and the United States of America with some suppliers of components coming from Chile, Israel, India, Portugal, and China. Such a market structure is attributed, first of all, to the historic spatial development of CSP facilities supported by government incentives and secondly, to the concentration of knowledge and capacities of the applicable industries.

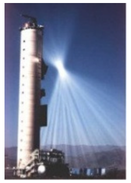
- The headquarters of CSP developers are concentrated in a few countries that actively supported the development of solar energy projects through their policies incentives, i.e. Spain and the USA. It is though expected that in the future the development of CSP facilities will extend to the Middle East and North African countries that possess better than average solar reserve. Thus new companies and partnerships are expected to emerge in this region.
- Due to the resource, technological, and economic considerations, the components that are least possible to localise in any given country include the receiver. Production of molten salt is also very difficult to localise, as it is highly dependent on access to caliche ore that is found in arid regions along the western coast of Latin America (Chile, Bolivia, and Peru).
- The components that can be easily localised include EPC contractor, civil works, and balance of the plant. Services of EPC contractor and civil works are integral elements of any construction project, whilst elements of the balance of the plant are common to most of the industrial processes.
- The rest of the components can be established using local manufacturing capabilities, but it will depend on the structure of that economy, logistics, and prices.

Given the types of industries that represent the companies that could produce components with high and medium procurement potential (see Table 2-1), further assessment should focus on determining the extent to which the following main industries are developed in the country and in the local economies (as per the standard Industrial Classification of StatsSA of 1993):

- Mining and quarrying sector
- Manufacturing, in particular:
    a. Manufacturing of other non-metallic mineral products
    b. Manufacturing of petroleum products, chemicals, rubber and plastic
    c. Manufacturing of metals, metal products, machinery and equipment
    d. Manufacturing of electrical machinery and apparatus
    e. Manufacturing of radio, TV, instruments, watches and clocks
- Construction sector
- Transportation and storage sector

Table 4-2: CSP using central receiver and molten salt technologies - market structure

Component	Market structure	Key considerations	Likelihood of local procurement	
Project developers 	• Small group of companies with technological know-how • Global player: Abengoa (Spain), Flagsol (Germany), SolarReserve (USA), Solel Solar System (Israel), Solargenix (USA), eSolar (South Africa), Ergon Energy (Australia), Kraftanlagen Munchen (Germany), BrightSource Energy (Australia)	• Includes many labour-intensive engineering activities, thus skills and knowledge are key • Requires access to finance and political support in the country where the project is to be established	Low	No direct R&D government support or known R&D partnerships with international role players
EPC contractor 	• Tasks can be performed by large engineering companies, but the number of experienced engineers with track record in CSP is limited • Most developers form partnerships with EPC contractors and establish new companies by doing so	• Requires project managers and engineers • Logistics, time-sharing and political aspects are taken into account when choosing the EPC	High	Local construction companies with proven record of big and similar projects
Civil works 	• Strong candidates available in most countries • Tasks performed by successful market players • Existing supplier structure can be used	• Plants and machinery are required • Semi-skilled and skilled construction workers required	High	Local construction (small, medium and large) can be employed
Heliostats 	• Flat precise mirrors have a limited target market • Global players: FLABEG Holding GmbH (Germany), Glasstech Inc. (USA), Guardian Ind. (USA), HEROGlas (Germany), Naugatuck Glass (USA), ReflecTech (USA), Saint-Gobain (Portugal), Pilkington (UK), Rioglass Solar (Spain), Cristaleria (Spain)	• Companies most likely need to set up new production lines, which is very capital intensive • Between 200 MW_e-400 MW_e required to make the new plant commercially viable • Cost of transportation is considered to be a decisive factor	Medium	Subject to economic feasibility by the local company
Mounting structure 	• Proprietary know-how of developers as it needs to match the heliostat design and the rest of the system • Global players: Abengoa (Spain), Acciona (Spain), Flagsol (Germany), Grupo Sener (Spain), Solargenix (USA), Solel Solar Sys. (Israel), Sky Fuel Inc. (USA), Albiasa (Spain), Alcova, Areva (USA), Novatec (Germany), Siemens (Germany)	• Steel supply can be provided by local companies; however, price of steel and quality thereof are important decision criteria • Parts can be manufactured using existing manufacturing capacities • Assembly can be sub-contracted	Medium	Subject to a competitive price of local steel and size of the local sector

Component	Market structure	Key considerations	Likelihood of local procurement	
Receiver 	• Limited target market at this stage, but it is expected to grow • Competition currently is small, but is expected to increase • Global role-players: Schott AG (Germany), Solel (Israel), Archimede Solar Energy srl. (Italy)	• Depends on the specific CSP market demand • Access to proven technologies/know how is required, which represents the high barrier for entry • Project-specific manufacturing process and coating activities - capital intensive	Low	Significant investment and access to highly skilled engineers plus limited market - high entry barrier
Molten Salt 	• Dominated by a few companies in the world • Global suppliers: Bertrams HEATEC AG (Switzerland), Durferrit (UK), Haifa Chemicals (Israel) , SQM (Chile), BASF (Germany), Pratt&Witney Rocketdyne (PWR) (USA)	• Dependent on access to raw-material • Highly capital intensive process to set up	Low	Access to raw material - high entry barrier
Storage system and piping 	• Requires process know-how • Limited target market • Global players (storage): Flagsol (Germany), Sener (Spain) • Global players (piping): Qbengoa (Spain), Acciona (Spain), ACS Cobra (Spain), Bharat Heavy Electrical Ltd. (India), Bilfinger Berger (Germany), Kafer	• Components of the system are not provide by only one company • Certain elements are standard to chemical and energy plants, thus they can be sourced from suppliers of these facilities • Economies of scale is important • Non-CSP market should create the largest demand	Medium	Certain elements can be procured locally
Power block 	• Turbines are manufactured by big industrial companies with long-term experience in the field • Global players (turbines): GE Oil & Gas (USA), Siemens (Germany), Bharat Heavy Electrical Ltd. (India), Ormat Tech. Inc. (USA), Pratt&Witney Rocketdyne (PWR) (USA), MAN Turbo (Germany)	• Very knowledge- and capital-intensive • Turbine manufacturing market is saturated • Other markets besides CSP need to be primary clients • Due to specialised nature of turbines – transport costs are irrelevant	Medium	Components besides steam turbine can be procured locally provided the local economy has the capabilities
Balance of the plant 	• Some equipment is specialised by market extends beyond CSP application	• Economies of scale is integral • Non-CSP market is the primary client	High	Certain components can be procured locally provided that local economy is inclusive of these activities

Source: The World Bank, 2011; RENAC, 2010

4.2 Local capabilities and capacities

The following paragraphs review the selected industries that offer opportunities for localisation of expenditure on the project in more detail. The analysis includes the disaggregation between the composition and dynamics of these industries in the country and in the local economy, i.e. the //Khara Hais LM.

Mining and quarrying sector

The importance of the mining and quarrying sector in the establishment of the CSP facilities lies in its ability to provide certain materials required in the construction activities as well as inputs required to produce other materials, such as steel, glass, and cement. Given the above, the main outputs that are of interest in this particular study include, inter alia:

- Aggregates and stone required in civil works
- Limestone and lime products required in cement manufacturing
- Iron ore required to produce steel
- Silica required to manufacture glass

The development of the mining sector in the country started in the 19th century with the discovery of gold and diamonds. Since then, the country's mining sector has diversified spanning numerous precious, metal and non-metal mineral products that the country is endowed with. About 60 different minerals are being actively mined in the country currently (Yearbook 2010/2011). These include, iron ore and industrial minerals used in the construction industry and in manufacturing of non-metal mineral products such as cement and glass.

It is estimated that there are some 674 producers of industrial minerals in **South Africa** (Yearbook 2010/2011). Of these, half of the producers are in the sand and aggregate sector and the rest encompass producers of clays for brick-making and special purposes (149), limestone and dolomite producers (40), dimension stone producers (61), salt producers (27), and silica producers (16).

In 2010, about 22.5 million tons of limestone and lime, 2.8 million tons of silica, and 52.1 million tons of aggregate and sand were produced by the companies involved in industrial mineral extraction and processing. As indicated in Table 4-3, most of the above-mentioned non-metal mineral products are sold locally, i.e. consumed by the industries located in South Africa.

Table 4-3: Selected industrial minerals production in South Africa, 2010

Commodity	Prerequisite for:	Production (tons)	Rand value (R'ml)	Local sales (R'ml)
Limestone and lime	Cement manufacturing	22 512 378	2 284	2 270
Silica	Glass manufacturing	2 854 736	472	470
Aggregate and sand	Civil works	52 086 663	3 828	3 828

Source: Quantec, SA Minerals and Energy Production, 2011

The sales volumes of the above-mentioned industrial minerals represent fractions of the gross output of the mining sector. However, it is believed that produced volumes as well as availability of the resources in the country make the procurement of selected industrial minerals possible within South Africa.

As far as the iron ore required for the production of steel is concerned, the country produced 58.7 million tons in 2010, which was worth R41.4 billion in nominal prices. Of these, 92.5% was exported and the rest was consumed within the country. This indicates that the majority of iron ore minerals produced in South Africa is exported in semi-processed form.

With respect to the **//Khara Hais local economy**, the only minerals amongst the ones that are being analysed that can be procured locally include aggregates and sand. For example, Idada Trading that is located in Upington and that is involved in the production of building materials and construction activities owns two plants in the area that produce crusher dust, natural and washed sand, as well as various types of aggregates. Kobus Duvenhage Building Contractors indicated that they have bought land to establish their own aggregate mining capabilities. All of the above suggests that the main building materials can be procured within the area.

The other minerals, such as iron ore, lime and silica (low-iron variety) are not known to be mined in the local municipality although deposits of iron ore do exist to the west of Upington (Kayamandi, 2010). Based on this, it is thus presumed that they cannot be procured locally; but nevertheless it can be sourced within other parts of the country.

Selected manufacturing industries

The manufacturing industries that form the focus of the analysis include industries that produce petro-chemical products, non-metal mineral products, steel and machinery, electrical machinery and equipment, and electronic instruments. In the **//Khara Hais LM,** the size of these types of industries ranges between R1.9 million and R29.6 million in current prices (refer to Table 4-4) and they are represented by small and medium enterprises that serve mostly demands generated by local residents and other economic sectors. These industries are small and do not encompass the specific manufacturing capabilities mentioned above. For example, it is known that the //Khara Hais economy does not have steel manufacturing, glass manufacturing, and cement manufacturing companies within its boundaries.

- The discussion with local construction companies highlighted that cement is usually procured from outside the area (i.e. Lafarge at Lichtenburg or Afrisam at Ulco).
- Steel products are bought from manufacturers and wholesalers all over the country depending on the type of steel products required. Examples of the steel suppliers to the local construction industry include Macsteel in Welkom, Clotan Steel in Klerksdorp, as well as the local supplier D&E Steel in Upington.

Based on the above it can thus be assumed that key manufacturing components required for the establishment of the CSP facility will not be procured from the local municipality as the local industries do not have the necessary capacities and skills to supply them at this stage. New manufacturing capabilities are possible to create; however, it is subject to the sufficient demand and economic feasibility. Some inputs required for the establishment of the CSP facility are required in large quantities (such as glass and mounting structures), but the demand created by one facility will not be sufficient to economically justify the establishment of new manufacturing capabilities within the local area. A significant greater demand for similar inputs is required to substantiate the investment in local capacities.

Selected manufacturing industries	South Africa		//Khara Hais		
	R'ml	% of total	R'ml	% of total	% of national
Petroleum products, chemicals, rubber and plastic	81 932	23.3%	29.6	13.70%	0.04%
Other non-metal mineral products	14 109	4.0%	8.1	3.78%	0.06%
Metals, metal products, machinery and equipment	80 701	22.9%	20.7	9.57%	0.03%
Electrical machinery and apparatus	8 082	2.3%	3.1	1.45%	0.04%
Radio, TV, instruments, watches and clocks	4 148	1.2%	1.9	0.89%	0.05%
Total Manufacturing	**352 176**	**100%**	**215.8**	**100%**	**-**

Table 4-4: Size of targeted sectors in the analysed economies (2011) *(Source: Quantec, 2011)*

Numerous solar energy projects proposed to be established in the Northern Cape and around Upington in particular are currently being investigated. Besides the Solar Park which is planned to be located next to the proposed project and which first phase includes the establishment of a 1GW solar park, local businesses indicated that a number of Environmental Impact Assessments for solar energy facilities are also under way in the area. The area is an attractive location for solar parks due to its relatively high solar irradiation, availability of water, and access to transmission infrastructure. If many similar solar energy projects are established in the area and these activities are co-ordinated to a certain degree, the establishment of local manufacturing capacities becomes feasible.

Currently, various government levels investigate the possibility of establishing the following infrastructure and industrial areas near Upington:

- The Airport Precinct at the Upington International Airport: The project is driven by the Airports Company South Africa (ACSA) and encompasses the establishment of the Cargo Hub with warehousing and cold storage facilities, aircraft parking and maintenance facilities, and possibly an aircraft recycling plant.
- Electronic Hubs at the Upington International Airport: The project is driven by the Department of Science and Technology and is aimed at capitalising on the opportunities created by the Karoo Array Telescope (MeerKat) and other astronomy facilities in the Northern Cape.
- The Industrial Development Zone (about 40 ha) planned to be established by the LM itself in proximity to the Airport. The industrial-like estate is also planned to be used to host suppliers and export-oriented manufacturers, including those operating in the green industries.

Although plans are underway to create environment conducive for the establishment of local manufacturing capabilities, it is not expected that these capabilities will become a reality by the time the proposed facility needs to be built, i.e. within a short-term.

With respect to the rest of the **country**, capacities and adequate knowledge to manufacture and supply glass, cement, and metal-based products do exist; however, a number of aspects need to be taken into account that might prevent the procurement of certain components within the country.

The two largest industries within the non-metal mineral products sector are cement (generated 50% of sector's sales in 2008) and glass (generated 21% of the sector's sales in 2008) manufacturing industries. Cement products used in the establishment of the CSP facility are conventional products used by construction industries in laying foundations and erecting building structures. Thus, companies manufacturing cement will not have to adjust their production capacities or range of products. The situation with glass though is different.

Glass required by the CSP facility using central receiver technology is not a conventional glass, although it can be manufactured by the same companies that produce automotive glass. It is flat and requires the use of low-iron sand. The market for this type of mirrors is limited and given the size of the order, most likely local glass manufacturing industries will need to expand their capacities to ensure that the supply to their usual customers is not jeopardised. Establishment of a new production line for manufacturing of flat mirrors for the heliostat field is a highly capital-intensive exercise that also needs some lead time to ensure mirrors produced are of adequate standard and quality. Furthermore, manufacturers will need to invest in research and testing capabilities, to ensure that glass is produced of high quality and can withstand certain weather conditions. Review of various studies suggest that production of mirrors for between 200MW_e and 400 MW_e is required to make such a project economically viable. Since the proposed project implies the manufacturing of mirrors for only 100MW_e, it is possible that the potential manufacturer would:

- either have to significantly raise a price of such mirrors to cover its costs, which would increase the capital expenditure of the project, or
- refuse to risk such investment without having more orders in place.

Government plans to procure additional 200 MW_e generated by CSP facilities owned by IPPs in the near future and significantly more in years to come. If varying technologies such as central receiver and parabolic trough are used in such projects, the initial stages of mirror manufacturing would still be similar. Thus, the possibility of creating sufficient economies of scale for glass manufacturers to establish new facilities does exist; however, due to uncertainties and financial risks, as well as lead time required for R&D activities to be conducted, a probability exists that mirrors for the first central receiver demonstration plant will have to be imported.

As far as metal products is concerned, South Africa has the capacity to produce required steel-based components; although given the fact that the global recession closed down a number of companies and forced other to re-structure, the capacities of the metal and metal products industry might need to be expanded in the future. The concern though is not in the capability of the national metal industry to supply necessary metal-based elements, but in the ability of the industry to produce at the required cost. Due to the pricing structure of selected steel products and relatively high labour costs, the price of steel within South Africa is comparable with the prices of steel in high price countries. Thus, locally produced steel is not always price-competitive compared to steel, for example, imported from China.

Due to the significant share of the total project expenditure carried by steel and steel structures, the price and quality of steel could be significant factors in deciding where the products are to be procured. Even though the composition of the metal, metal products, machinery and equipment industry in South Africa bodes well for the use of local capabilities, uncompetitive steel prices and the need in some cases for expert knowledge in production of certain components might prevent this opportunity from being fully realised. This is particularly applicable to the manufacturing of such components as mounting structures, storage tanks, and feed heaters as they represent the biggest costs items that could potentially be procured locally and that rely on steel as a key input material.

With respect to electrical machinery and apparatus, as well as instruments, the country's capability to provide more conventional elements of the system is deemed to be acceptable. Certain elements of the system, in particular electronic components, do not have a large general market and require certain production expertise which South Africa does not possess. Thus, some elements of the system procured from the electrical machinery and apparatus industry, as well as the instrument manufacturers that will need to be imported.

Construction sector industry

South Africa has a well-developed construction industry comprising of large companies and Small, Medium, and Micro Enterprises (SMMEs). In 2007, large construction enterprises accounted for almost 60% of all income generated by the construction sector (StatsSA, 2007). These enterprises are also the most dominant types of enterprises that operate in the construction of civil engineering structures sub-sector. The above is indicative of a relatively large experience that has been developed by the construction industry in South Africa and the concentration of this experience amongst the large enterprises. EPC contractors generally encompass large construction companies with years of experience in managing establishing large building and civil projects. Local construction companies have successfully delivered on large investment projects such as power plants, transport infrastructure, and stadia in the past. Therefore, it is believed that the potential EPC contractor could be procured locally. Furthermore, due to the structure of that industry much of the construction activities will be sub-contracted.

The //Khara Hais construction industry is small, but is steadily growing. It also accounts for about half of the construction industry of the district. Some of the major construction companies in the area include, inter alia:

- Idada Trading that also encompass Poort Beton and Strauss Seviel companies and that largely focuses on civil construction activities and plant hire, and
- Kobus Duvenhage Building Contractors that has been involved in construction of various residential estates, office buildings, shopping centres, and even Eskom's Tests Site In Upington in the past and that is currently managing the construction of the Upington Hospital

Many other smaller construction companies are also established in the area. All of the above suggests that the local construction in industry in //Khara Hais has the capabilities to be involved in civil works and building construction activities on site. Some other activities could potentially be also sub-contracted to the local companies; however this would be subject of availability of required skills. The discussion with the above-mentioned construction companies, though, highlighted that technical expertise and other specialised knowledge is difficult to find in the area, which forces these companies to import the necessary expertise as far as Johannesburg and Cape Town. Therefore, although local construction companies could be involved in the establishment of the proposed facility, it is expected that some of the employment opportunities created as a result of this could be filled by people coming from outside the local municipality.

Transport and storage sector

South Africa encompasses four transport typologies, i.e. roads, air, maritime, and rail.

- The **road** network in the country spans more than 740 thousand kilometres with national roads traversing each province and connecting the country with its neighbouring states. In 2008, 1.4 billion tons of freight at an average transport distance of 185 kilometres per trip was transported on road (Yearbook 2010/2011). The busiest road freight corridor in the country is between Johannesburg and Durban.
- **Rail** freight is managed by Transnet. In 2008, 204 million tons at an average transport distance of 640 kilometres per trip was transported by rail (Yearbook 2010/2011). Over the last decade, though, freight transportation by rail has been decreasing at a fast pace largely due to the problems associated with efficiency and capacities thereof. Plans are in place to address the weaknesses of the rail transport sector, increase its reliability and thus move some of the freight from road to rail.
- The country has nine **ports** and they play an important role in the socio-economic development of the country as the majority of exports and imports in the country are being handled through sea ports (Yearbook 2010/2011). In 2008, more than 185.1 million tons of cargo has been processed at the country's ports, almost half of which was handled at the Richards Bay Port (Department of Transport , 2008).

- The country has nine international airports, inclusive of Upington International Airport and an additional fourteen national airports. In 2008, 88.9 million passengers and 225 thousand tons of cargo were transported by air in South Africa. Upington International airport accounted for the smallest share of passenger and cargo transportation, but plans are in place to repartition this airport as a major cargo hub.

In 2006, the transport and storage industry derived income to the value of R174 196 million. In terms of four transport topologies, air transports earned the greatest income, followed by road transport (StatsSA, 2006). More than three quarters of the transport industry's income is derived by large transport enterprises (with an income of over R26 million per annum) (StatsSA, 2006).

With respect to the local municipality's transportation industry and infrastructures, the following could be highlighted:

- The //Khara Hais LM, as well as the rest of the Northern Cape Province, has a very well maintained and extensive road network. Upington in particular is linked with major cities in the country through the N10 (Port Elizabeth), the N8 (Kimberley and Bloemfontein), and the N14 (Johannesburg). It also hosts a head office of MacDonald's Transport and Warehousing, which core business is bulk transport. It has permanent depots in Cape Town, Johannesburg, Durban, Richards Bay, Bethal, Vryburg, Harrismith and seasonal depots in Tshipise, Nelspruit, and Aussenkehr.
- The LM is also traversed by a railway that links the country with Namibia through the De Aar rail hub. It appears though that is it is not being utilised at this stage from Upington and it is unknown whether any significant investment is required to make local infrastructure operational. It should be noted though that the largest constraining factor of rail freight development in the country is the availability of rolling stock and reliability of the delivery services.
- The Municipality also boast Upington International Airport that has the longest runway in the country and that is strategically positioned to allow transportation of goods from the nearby regions and to the country itself.

All of the above suggests that South Africa has a well-developed transportation industry and transport infrastructure to manage the delivery of project's components from overseas and within the country. The //Khara Hais LM offers opportunity to transport goods by both road and air. Furthermore, local companies such as MacDonald's Transport could be employed in performing the necessary transportation services due to the established network of depots in their ownership at different ports and hubs in the country.

CHAPTER 5. PROJECT ASSUMPTIONS

The following sections outline the assumptions used in the modelling exercise. These assumptions were developed on the basis of data obtained from various sources, such as Eskom and international CSP studies, as well as the results of the localisation opportunities assessment provided earlier in the report.

5.1. Construction phase cost and localisation assumptions

The proposed 100 MW_e CSP facility using central receiver and molten salt technologies is planned to be established during the period between 2013 and 2016, taking a total of 30 months to complete. The establishment costs are estimated to be US$ 663 million, which equates to R4 844.3 million in current prices assuming a R7.39/US$ exchange rate. Assuming that all possibilities are explored to increase the local expenditure of the project, R2 637 million in current prices, or 54% of the total project expenditure will be possible to localise in the country. Of this, 9.8% will be spent within the local economy itself. These assumptions represent a **high road scenario**, which in turn implies that mirrors and steel-based components can be procured from within South Africa.

The breakdown of the project's costs and their localisation potential for the high road scenario is summarised in Table 5-1. A more detailed breakdown can be found in Annexure A.

Table 5-1: Construction cost breakdown estimates (R'ml, 2011 prices)

Components	Project cost, R'ml	% of total procured from SA	% of SA costs from local economy	Project expenditure in SA		
				Total SA	Local economy	Rest of SA
Structures and improvements	11.0	100%	12%	11.0	1.3	9.7
Heliostats	1 482.1	57%	1%	840.4	6.1	834.2
Central receiver/tower	823.2	12%	43%	96.6	41.5	55.1
Working fluid (molten salt)	213.2	0%	0%	-	-	-
Storage and heat transfer systems	205.1	29%	19%	58.8	11.4	47.4
Power block facility	748.7	73%	5%	545.1	27.8	517.4
Balance of plant	367.7	86%	0%	314.7	-	314.7
Site work and infrastructure	143.1	100%	50%	143.1	71.5	71.5
Transport costs	81.7	100%	50%	81.7	40.9	40.9
EPC mark-up	308.7	100%	0%	308.7	-	308.7
Labour	459.9	52%	24%	236.9	57.0	179.9
TOTAL	**4 844.3**	**54.4%**	**9.8%**	**2 637.0**	**257.6**	**2 379.4**
% of project cost	100.0%	54.4%	9.8%	54.4%	5.3%	49.1%
Employed (FTE over construction)	-	-	-	1 304	492	812

Source: Data gather through interviews with Eskom representatives, 2011; information obtained from Fichtner (2010) and the World Bank (2011); knowledge of the local and national economies' composition

The following with respect to the high road scenario should be highlighted:

- Amongst the components of the project, the receiver and molten salt will be imported.
- Construction activities and transportation are assumed to be undertaken by companies established in South Africa. This means that all expenditure on civil works, construction of buildings, and transportation will be localised. Furthermore, half of the transportation and civil works expenditure can be spent within the local economy.
- The majority of components for the power block facility and balance of the plant can be bought within the country. However, due to the composition of the local economy only a small percentage of costs involved in the power block establishment can be contained within the local economy (mainly on construction activity).
- Some elements of the storage and heat transfer system can also be procured from within the country and civil works involved in setting up the system will be localised within the //Khara Hais economy.
- Due to the nature of the project, much of the expertise required in assembly and completion of the project will come from other countries, particularly from the company that carried the know-how for the central receiver technology. Due to the nature of expertise required and relatively high salary packages expected to be paid to the foreign professionals, only half of the labour costs is expected to be spent within the country. Of this, about 24% will be spent on labour employed by the local construction companies involved in the project.
- A total of 1 304 Full Time Equivalent (FTE) jobs will be created during construction in the case of the high road scenario, which equates to an average of 522 employment positions for the entire duration of construction. Over a third of these will be created within the //Khara Hais industries and the rest within companies located throughout the rest of the country.

The analysis of localisation opportunities highlighted that the possibility of the procurement of heliostat mirrors and main steel structures from South African manufacturing companies is subject to a number of conditions. If any of these conditions do not realise and the procurement of mirrors and/or steel structures from within the country becomes financially unviable, the project expenditure in the country will be significantly reduced. This will in turn diminish the economic impact created by the project during construction. In order to account for such circumstances, **additional three scenarios** were created. These are:

- Middle Road A scenario: it assumes that manufacturing capacities to produce high quality flat mirrors for the solar field are not yet established, thus the mirrors are being imported
- Middle Road B scenario: it assumes that the local price of steel is uncompetitive and that main steel structures, including mounting structures for mirrors, storage tanks, and feed heaters, are imported
- Low road: it assumes that both mirrors and steel structures are imported

Table 5-2 provides a summary of the assumptions used in the modelling of the above-mentioned scenarios. It shows that the retention of expenditure on the project drops from 54% in the case of the High Road scenario to 33% in the case of the Low Road scenario. It is also clear that the loss of local procurement is smaller in the case of the Middle Road A than in the case of the Middle Road B.

Table 5-2: Construction period localisation scenarios – summary (R'ml, 2011 prices)

Scenarios	Note	Project cost	Procured in SA	% of project cost	Local split	
					LM	Rest of SA
High road	Original assumptions	R 4 844.3	R 2 637.0	54%	R 257.6	R 2 379.4
Middle road A	Mirrors are imported	R 4 844.3	R 2 335.1	48%	R 257.6	R 2 077.5
Middle road B	Steel structures imported	R 4 844.3	R 1 892.0	39%	R 257.6	R 1 634.4
Low road	Mirrors & steel structures imported	R 4 844.3	R 1 590.1	33%	R 257.6	R 1 332.5

Source: Urban-Econ estimations based on economic intelligence, 2011

Table 5-3 outlines the changes in the cost breakdown that are associated with each scenario. It is clear that only three costing items are being affected by the assumptions with respect to changes in localisation potential. These are heliostats, thermal storage and heat transfer systems, and the power block facility. It should be noted that the total labour costs, as well as the number of FTE jobs to be created on site are not being affected by these changes.

Table 5-3: Construction period localisation scenarios – cost breakdown (R'ml, 2011 prices)

Components	High road	Middle road A	Middle road B	Low road
Structures and improvements	R 11.0	R 11.0	R 11.0	R 11.0
Heliostats	R 840.4	R 538.4	R 314.1	R 12.2
Central receiver/tower	R 96.6	R 96.6	R 96.6	R 96.6
Working fluid (molten salt)	R 0.0	R 0.0	R 0.0	R 0.0
Storage and heat transfer systems	R 58.8	R 58.8	R 29.7	R 29.7
Power block facility	R 545.1	R 545.1	R 355.5	R 355.5
Balance of plant	R 314.7	R 314.7	R 314.7	R 314.7
Site work and infrastructure	R 143.1	R 143.1	R 143.1	R 143.1
Transport costs	R 81.7	R 81.7	R 81.7	R 81.7
EPC mark-up	R 308.7	R 308.7	R 308.7	R 308.7
Labour	R 236.9	R 236.9	R 236.9	R 236.9
TOTAL	**R 2 637.0**	**R 2 335.1**	**R 1 892.0**	**R 1 590.1**
% of project cost	54.4%	48.2%	39.1%	32.8%
Employed (FTE over construction)	1 304	1 304	1 304	1 304

Source: Urban-Econ estimations based on economic intelligence, 2011

5.2. Operational phase cost and localisation assumptions

The proposed 100MW_e CSP facility is expected to generate about 483 552 MWh of electricity. This is assuming a capacity factor of 60% and plant availability rate of 92%. The cost of electricity produced by the facility is a standard Eskom tariff that is subject to the approval received from the National Energy Regulator Authority (NERSA). Assuming a price of electricity at 52.30 c/kWh, which was approved by NERSA on 10 February 2010, the annual turnover of the proposed facility will equate to R251.45 million in 2011 prices. This, though, is expected to change in the future as the electricity tariff changes; however, for the purpose of this study this turnover is assumed to remain the same throughout the project's operational period. The latter, in turn, is assumed to continue over 25 years.

Operational expenditure of the proposed facility is expected to amount to R79.8 million in 2011 prices, as indicated in Table 5-4. All of the services and materials required for continuous operations, except for some components that might need to be imported for maintenance, will be procured within South Africa. Furthermore, labour expenditure and spending on business services will be possible to localise within the //Khara Hais LM.

Table 5-4: Operational phase cost breakdown, (R'ml, 2011 prices)

Components	Project cost, R'ml	% of total procured from SA	% from local economy	Project expenditure in SA		
				Total SA	Local economy	Rest of SA
Solar field	R 22.5	100%	0%	R 22.5	R 0.0	R 22.5
Power block	R 13.2	100%	0%	R 13.2	R 0.0	R 13.2
Insurance	R 15.7	100%	0%	R 15.7	R 0.0	R 15.7
Water	R 0.5	100%	0%	R 0.5	R 0.5	R 0.0
Fuel	R 2.0	100%	0%	R 2.0	R 0.0	R 2.0
Other	R 5.3	50%	100%	R 2.6	R 2.6	R 0.0
Labour	R 20.7	100%	100%	R 20.7	R 20.7	R 0.0
TOTAL	**R 79.8**	**97%**	**31%**	**R 77.1**	**R 23.8**	**R 53.3**
% of project cost	100%	97%	31%	97%	30%	67%

Source: Data gather through interviews with Eskom representatives, 2011; information obtained from Fichtner (2010); knowledge of the local and national economies' composition

The proposed CSP facility will create 72 permanent employment opportunities, the majority of which are for skilled and highly skilled professionals (Table 5-5). Due to the skills requirements, only a few of the positions at the facility are expected to be filled by local labour. These are largely semi-skilled and unskilled positions of security guards, heliostat field cleaning crew, and administrative personnel. Most of the skilled and highly skilled positions will most probably be filled by people who will need to re-locate to the local municipality from other parts of the country. A few of the positions, though, require knowledge of the specific technologies used in the facility. Since such technologies have not yet been implemented in the country it is unlikely that these positions can currently be filled by the South African labour. However, Eskom indicated that training programmes are in place to develop skills and knowledge of local professionals by sending them on training and exchange programmes prior the operations commence. Thus, it is assumed that by the time Solar 1 starts operating all positions at the CSP facility will be filled by adequately skilled South African residents.

Table 5-5: Staff count during operations of the proposed project and possibility of filling the position from the LM and the rest of the country assuming Eskom's training programmes

Position	Staff count	Skills requirements	Possibility to fill the position	
			In SA	In LM
Administrative	**11**			
Plant Manager	1	Power Generation Experience	✓	
Secretary	1	Admin and support skills		✓
HR Practitioner	1	Human resource knowledge and skills		✓
Computer Technician	1	Hardware and software knowledge	✓	
Plant Engineer	5	Engineering degree and experience in CSP	✓	
Performance Engineer	1	Engineering degree and experience in CSP	✓	
Planner/Purchasing	1	Commercial process and procurement skills	✓	
Operations	**37**			
Operations Manager	1	Power Generation Experience and Operation	✓	
Assistant Operations Manager	1	Power Generation Experience and Operation	✓	
Senior Operators	3	Plant operation and plant knowledge-SOPs	✓	
Control Room Operator	20	SCADA system knowledge and plant operation	✓	
Plant Equipment Operator	1	Plant operation and plant knowledge	✓	
Ass. Plant Equipment Operator	1	Technical knowledge in plant operations	✓	
Mirror Wash Labourers	8	Ordinary semi skilled labour		✓
Chemical Technician	2	Chemical processed water treatment plant & molten salt	✓	
Power Plant Maintenance	**10**			
Maintenance Supervisor	1	Power generation knowledge and plant maint.	✓	
Plant Maintenance Foreman	1	Maintenance and repair experience	✓	
Electricians	3	Knowledge of medium & low voltage equipment and plant maintenance	✓	
Instrument Technicians	2	Knowledge of the SCADA system -controls and instrumentation maintenance	✓	
Fitter and turner	3	Trade test certificate as fitter - knowledge of plant maintenance	✓	
Solar Field Maintenance	**5**			
Mechanical Technician	1	Knowledge and experience in installation, maintenance and repair of solar field components	✓	
Field Technician	2	Knowledge and experience in solar field installation and repair	✓	
Field Labourer	2	No special skills requirements		✓
Other	**9**			
Security	9	No special skills requirements		✓
TOTAL	**72**			

CHAPTER 6. IMPACT ASSESSMENT RESULTS AND INTERPRETATION

This chapter presents the results of the economic modelling exercise and interprets this information in the context of the national and local economies. Due to the duration of impacts expected during various stages of the project's lifecycle, the analysis of the impacts is disaggregated between those that occur during construction and those that are expected to take place during operations. In addition to the above, the project's is reviewed in the context of its alignment with the current policy environment.

6.1 Economic impacts during construction

Expected economic impacts during construction include possible changes in the balance of payment, impact on production or business sales, impact on value added or GDP-R, changes in the employment situation, and effects on income levels of directly and indirectly affected households. All of these impacts are analysed in detail further in the section.

Impact on balance of payments

The proposed facility will cost R4 844 million to build, of which only 54% will be spent within the country. This means that the rest of the project expenditure will be used to import foreign goods and services, which represents a leakage from the country. Any purchase of imported goods and services in South Africa is accounted in the Current Account under either "merchandise imports" or "payments for services". Thus, R2 207 million in current prices that is expected to be spent on imported components of the project will be disaggregated between these two sub-accounts.

In 2010, the country's current account inflows equated to R761.8 billion, whilst its international outflows were valued at R 836.8 billion. Thus, South Africa had a current account deficit of R75 billion, which means that the country spent more than it earned during the same period and thus had a trade deficit (Figure 6-1).

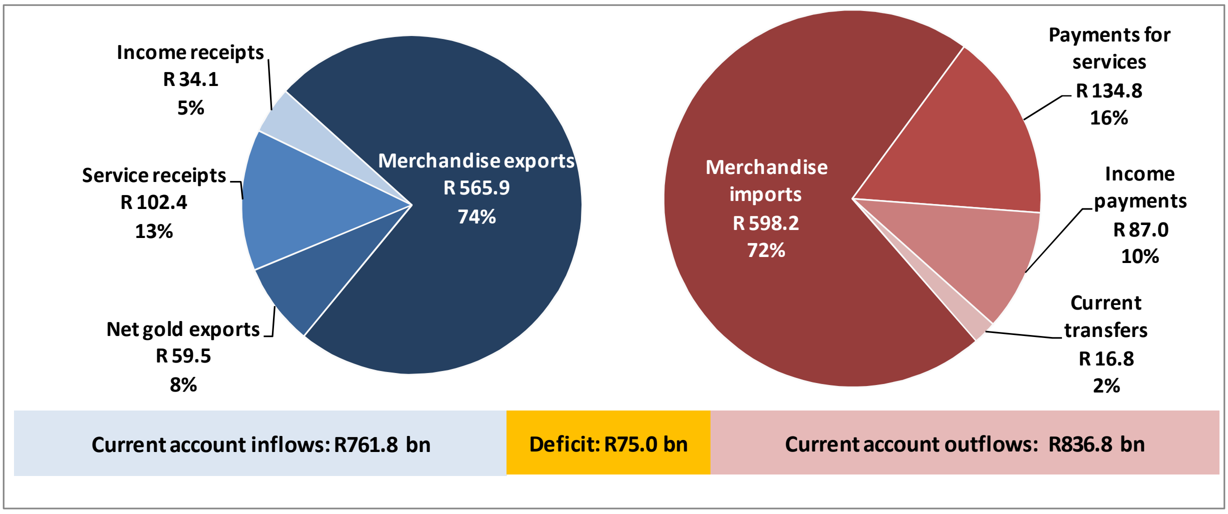


Figure 6-1: Current account inflows and outflows per item, 2010
(Source: SARB Annual Bulletin, 2010)

Since 2003, the country has been running a negative balance of payment with values of imports and other account outflows exceeded the country's international earnings. In 2008, the current account deficit was the largest in the decade amounting to about 7.1% of the GDP-R of the same year. Therefore, the global financial crises resulted in the reduced trade flows between the countries and subsequently lead to the decline of the current account deficit in South Africa. In 2010, the current account deficit was only 2.8% of the national GDP-R.

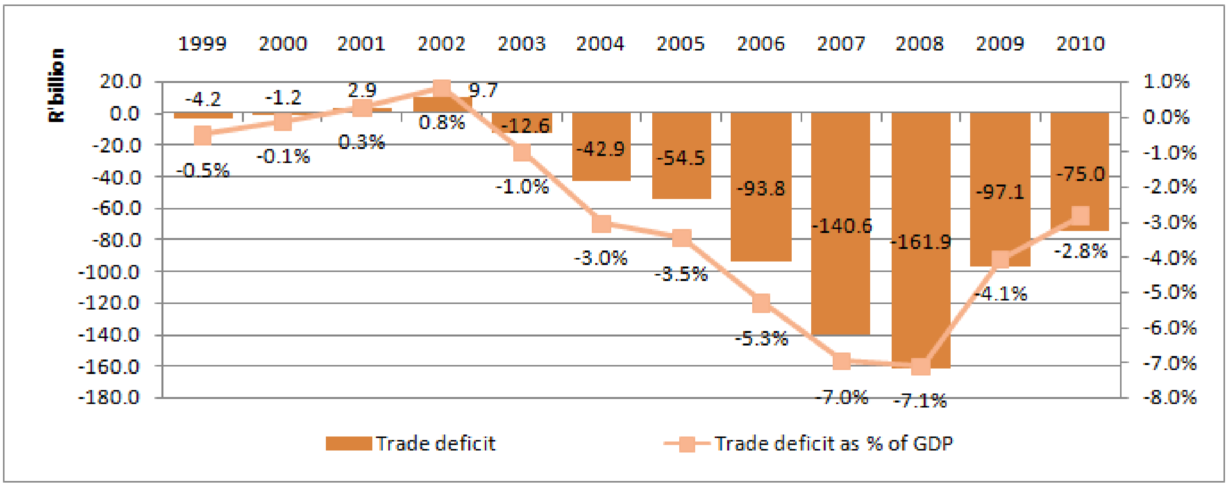


Figure 6-2: South Africa's balance of payments (1999-2010)

(Source: SARB Annual Bulletin, 2010)

If the imported goods and services required for the establishment of the proposed facility are all acquired in one year, the current account outflows will increase by about R2.2 billion in current prices. Assuming that the current account dynamics do not change, this would increase the deficit on the current account by about 2.9% and increase the current account deficit as a percentage of the GDP-R to 2.9%. This is not a significant change and it is not expected to have any impact on the monetary or fiscal policies of the country. Moreover, a negative balance of payments in a developing economy such as South Africa is generally acceptable as the economy needs to borrow money to allow it to invest in infrastructure, people, and businesses that eventually propel growth in the years to come. Care though should be taken to ensure that the current account deficit does not grow beyond the means of the country to service its debt and that the economy is not forced into a default position, as happened recently with Greece.

Impact on production

The establishment of the proposed Solar 1 will stimulate business sales throughout the entire economy for the period of two and a half years. As indicated in Table 6-1, procurement of goods and services in the country to the value of R2 637 million in 2011 prices will increase the production of the country's economy by R7 932 million in 2011 prices in the case of the High Road scenario. About two thirds of this output will be generated through indirect and induced effects.

The distribution of new business sales in South Africa will largely be skewed towards the rest of the country, as the local and provincial economies are not sufficiently diversified to not only supply goods and services to the EPC contractor but also to provide the necessary inputs to the suppliers of these goods and services and produce goods and services demanded by households. Nevertheless, the local and provincial economies are expected to benefit from the project too.

Table 6-1: Impact on production during construction – high road scenario (R'ml, 2011 prices)

Year	Direct	Indirect	Induced	Total	% share
Local economy	R 257.6	R 33.6	R 11.4	R 302.7	3.8%
Rest of the Northern Cape	R 0.0	R 269.5	R 94.2	R 363.7	4.6%
Rest of SA	R 2 379.4	R 2 750.3	R 2 136.3	R 7 266.0	91.6%
Total in SA	**R 2 637.0**	**R 3 053.4**	**R 2 241.9**	**R 7 932.3**	**100.0%**

As indicated in Table 6-2, the local economy's business sales are expected to grow by R302.7 million in current prices over the project's establishment period. The construction sector is expected to be the biggest benefactor of this increase, with the transport sector estimated to have the second biggest increase in production. The Northern Cape economy's output is expected to grow by R363.7 million in current prices. The distribution of new business sales in the provincial economy will be more balanced than in the local economy. The biggest increase in production, though, is expected in the provincial manufacturing and transport sectors. As far as the rest of the country is concerned, sectors with the largest increase in production are expected to be construction and manufacturing. Construction though will largely benefit through direct effects, whilst manufacturing will largely benefit through the increase in procurement along with the manufacturing value chains stimulated by indirect and induced effects.

Table 6-2: Sectoral and spatial distribution of new business sales stimulated by project expenditure - high road scenario (R'ml, 2011 prices)

Economic sector	Local economy	Rest of Northern Cape	Rest of SA	Total in SA
Agriculture	R 0.7	R 7.9	R 84.2	R 92.8
Mining	R 3.6	R 26.0	R 137.3	R 166.9
Manufacturing	R 0.6	R 97.2	R 2 334.3	R 2 432.2
Utilities	R 0.7	R 4.4	R 101.5	R 106.5
Construction	R 268.7	R 37.3	R 2 529.2	R 2 835.2
Trade and accommodation	R 3.5	R 28.6	R 608.8	R 640.9
Transport	R 15.1	R 85.3	R 486.2	R 586.6
Financing	R 5.0	R 29.1	R 383.9	R 418.0
Business services	R 0.5	R 5.3	R 351.9	R 357.7
Services	R 4.4	R 42.6	R 248.6	R 295.6
Total	**R 302.7**	**R 363.7**	**R 7 266.0**	**R 7 932.3**

In the scenarios when mirrors, steel structures or both cannot be procured within the country and are imported, the production stimulated by the project expenditure in South Africa will be reduced significantly. As illustrated in Figure 6-3, Middle Road A (imported mirrors) will stimulate the production of 14% less output than the High Road scenario, whilst Middle Road B (imported steel structure) will generate only about two thirds of the production that is projected to be stimulate by the High Road. The combination of the two Middle Roads, i.e. Low Road, will means 46% lower output in the national economy than the most beneficial scenario.

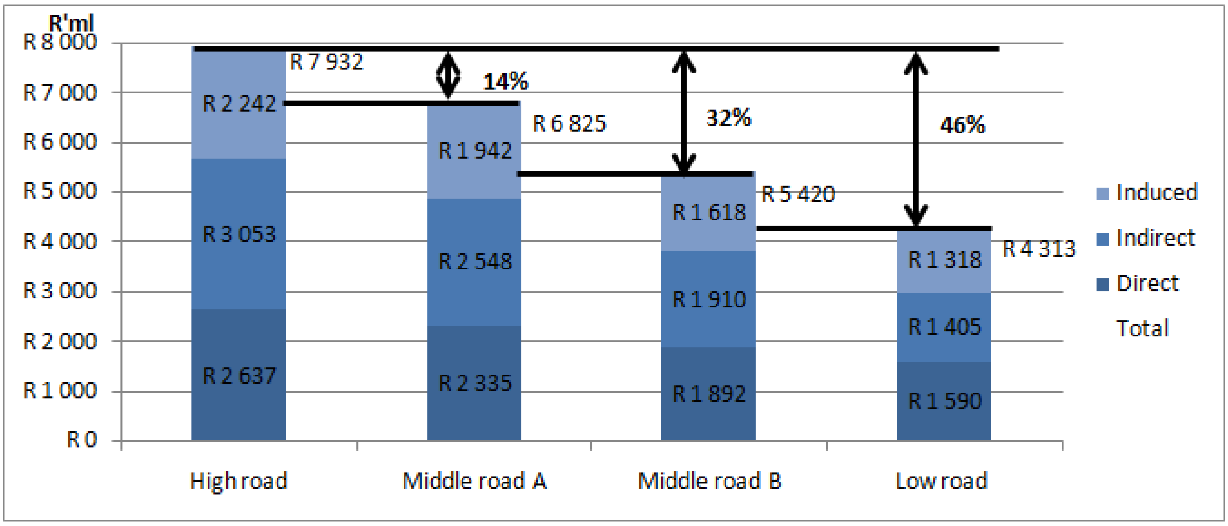


Figure 6-3: Impact on production sensitivity analysis (R'ml, 2011 prices)

Impact on GDP-R

The expenditure to the value of R2 637 million on the procurement of components and services for Solar 1 will generate value added to the amount of R2 624.8 million in 2011 prices. Of this, approximately one out of every five Rand will be created through direct effects, i.e. in the construction sector itself, whilst the rest will be created through indirect and induced effects (Table 6-3). Increase in business sales of the suppliers to the projects and suppliers to these suppliers will generate R1 077.7 million of value added; whilst an increase in household spending, which comes as a result of additional household income stimulated through direct and indirect effects of the project, will generate an additional R990.2 million in value added.

Table 6-3: Impact on GDP-R during construction – high road scenario (R'ml, 2011 prices)

Year	Direct	Indirect	Induced	Total	% share
Local economy	R 57.8	R 12.4	R 5.2	R 75.5	2.9%
Rest of the Northern Cape	R 0.0	R 97.5	R 40.9	R 138.4	5.3%
Rest of SA	R 499.1	R 967.7	R 944.2	R 2 410.9	91.9%
Total in SA	**R 556.9**	**R 1 077.7**	**R 990.2**	**R 2 624.8**	**100.0%**
% split	21%	41%	38%	100%	-

As in the case with the production impacts, changes in GDP-R during the construction period will be temporary and will largely be spread amongst the entire country rather than be localised within the Northern Cape Province or the local municipality. Local economy's GDP-R during the two and a half years of construction will grow by R75.5 million in 2011 prices, which is an equivalent of 1.6% of the current size of the //Khara Hais economy (Table 6-4).

The rest of the Northern Cape Province will experience and increase in value added by an additional R138.4 million, which is coupled with the impact on the local economy equates to 0.4% of the provincial economy. If construction were to take place in 2011 and would spread over one year, the country's economy would have grown by about 0.1%.

Table 6-4: Impact on GDP-R relative to the size of economies - high road scenario

Economy	2011 (R'ml, current prices)	Impact during construction (R'ml, 2011 prices)	Temporary change in economy
Local economy	4 795.9	R 75.5	1.6%
Northern Cape	53 222.0	R 213.8	0.4%
South Africa	2 637 800.7	R 2 624.8	0.1%

Economic sectors in the country that are expected to experience the largest increase in their GDP-R as a result of the project's expenditure during construction include the manufacturing and construction industries (Table 6-5). Amongst the manufacturing industries, the largest economic benefit will be incurred by the non-metallic mineral products industry, basic metals products, and structural steel products industries. Tertiary sectors, in particular trade and insurance industries will also be notably stimulated. As indicated in Table 6-5, the construction sector will grow by the largest amount in the local economy, whilst the manufacturing and transport sectors (similar to the production effects) will experience the greatest growth in value added in the rest of the province.

Table 6-5: Sectoral and spatial distribution of impact on GDP-R during construction - high road scenario (R'ml, 2011 prices)

Economic sector	Local economy	Rest of Northern Cape	Rest of SA	Total in SA
Agriculture	R 0.3	R 3.7	R 43.2	R 47.2
Mining	R 1.9	R 13.9	R 73.8	R 89.6
Manufacturing	R 0.2	R 26.7	R 594.9	R 621.8
Utilities	R 0.3	R 1.9	R 50.8	R 53.0
Construction	R 60.7	R 9.7	R 541.4	R 611.7
Trade and accommodation	R 1.6	R 13.0	R 310.3	R 324.9
Transport	R 5.5	R 31.4	R 232.0	R 268.9
Financing	R 2.7	R 16.3	R 236.2	R 255.2
Business services	R 0.2	R 2.0	R 197.1	R 199.3
Services	R 2.1	R 19.9	R 131.2	R 153.1
Total	**R 75.5**	**R 138.4**	**R 2 410.9**	**R 2 624.8**

In the situation when manufacturing of mirrors, required steel structures or both within South Africa fail to realise, value added generated by the project expenditure could drop by 37% or R979 million in 2011 prices. All sectors in the national economy will lose in this case as local expenditure on procurement of goods means lower spending along the backward linkages and lower household income generated through indirect effects. The biggest loss of potential value added, though, will be experience by the trade, finance and insurance services, non-metallic mineral products, metal products, transport services, real estate, mining and structural steel products industries. In the case of Middle Road scenarios, the potential loss of value added will be smaller, but between Middle Road A and Middle Road B, the latter will be associated with the greater loss than the former.

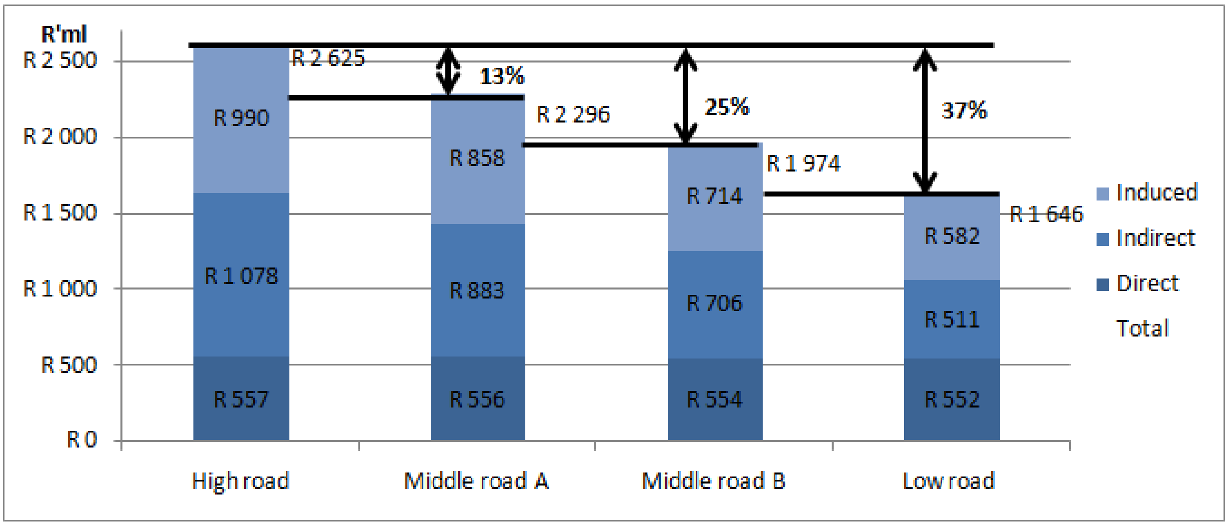


Figure 6-4: Impact on GDP-R sensitivity analysis (R'ml, 2011 prices)

Impact on employment

During the construction of Solar 1 about 12 164 FTE employment will be created. This does not mean that more than 12 thousand employment positions will be created at one point in time during the construction period. It rather means that during the establishment stage 12 164 employment person-years will be created, which equates to about 4 866 workers being employed for the duration of the construction period. In reality though, the number of temporary jobs created as a result of the project's spending will vary throughout the years and will follow a project expenditure schedule.

The greatest number of FTE employment will be created through indirect effects, i.e. amongst companies and businesses that would supply goods and services to the construction and the companies that would provide inputs to these suppliers. It is estimated that 6 094 employment person-years could be created along the supply value chains of companies that would provide goods and services for the establishment of Solar 1. Income effects derived from increased household spending are expected to stimulate the creation of an additional 4 766 FTE jobs. On site activities will create direct 1 304 FTE jobs. Given that the construction of the facility will last for two and a half years, an average number of 522 workers is expected to be on site during that period.

Table 6-6: FTE employment created during construction – high road scenario

Year	Direct	Indirect	Induced	Total	% share
Local economy	492	95	31	618	5.1%
Rest of the Northern Cape	-	651	218	869	7.1%
Rest of SA	812	5 347	4 517	10 676	87.8%
Total in SA	**1 304**	**6 094**	**4 766**	**12 164**	**100.0%**
Average annual employment position	522	2 438	1 906	4 866	-

Most of the employment opportunities created during construction will be created outside the Northern Cape Province, inclusive of the local municipality. As indicated in Table 6-7, the sectors with the largest expected positive changes in employment include, inter alia:

- Manufacturing, in particular non-metallic mineral products, basic metal, and structural metal industries stimulated through indirect effects and textile and clothing and food and beverages industries stimulated through induced effects
- Agriculture, which will be stimulated through increased consumer spending
- Construction, which will be stimulated through direct effects
- Trade and accommodation sectors stimulated almost equally by indirect and induced effects

Employment opportunities for the local economy and the rest of the Northern Cape economy are limited compared to the ones to be created in the rest of the country. It is estimated that locally, only 618 out of 10 676 FTE jobs could be temporary established. Most of these will also be created in the construction industry and will be established on site itself. Some of the construction jobs will be possible to fill by local labour, however given the shortage of skills in the municipality, local construction companies will most likely have to resort to importing skilled workers from other parts of the district or even the country.

Table 6-7: Sectoral and spatial distribution of employment person-years created during construction – high road scenario

Economic sector	Local economy	Rest of Northern Cape	Rest of SA	Total in SA
Agriculture	8	57	894	958
Mining	0	45	371	416
Manufacturing	37	231	3 631	3 899
Utilities	1	2	128	130
Construction	517	168	1 475	2 160
Trade and accommodation	20	106	1 699	1 825
Transport	15	84	620	719
Financing	2	20	670	692
Business services	2	19	614	635
Services	16	138	576	730
Total (FTE employment)	**618**	**869**	**10 676**	**12 164**

Changes in the procurement pattern that could be expected in the cases of failure to secure supply of locally manufactured mirrors, steel structures or both are associated with colossal numbers of unrealised employment opportunities. As illustrated in Figure 6-5, between 1 934 and 4 990 FTE jobs could be unrealised if any of the scenarios besides the High Road scenario is realised. The worst case scenario is the Low Road scenario that prevents five thousand employment person-years from being localised. Given the current employment situation and particularly the need to develop new and improve skills of the labour force, the Low Road scenario carries significant social and economic opportunity costs for the country. Between the middle road scenarios, the biggest number of unrealised employment opportunities is intrinsic to the Middle Road B scenario that assumes the need to import steel structures. This suggests that in order to maximise the number of jobs created by the project in the green industry, the primary focus should be on ensuring the procurement of steel and steel structures within South Africa. Establishment of local capabilities to supply flat mirrors for the CSP facility and similar projects, should not be ignored either as it is associated with the creation of 1 934 FTE jobs throughout the entire economy and not just in the glass manufacturing industry.

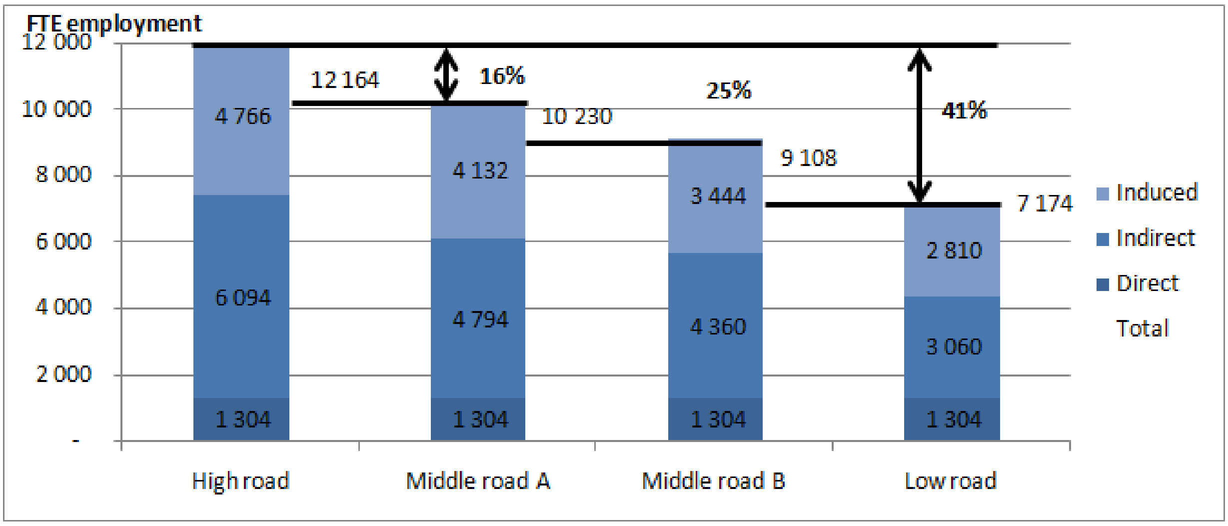


Figure 6-5: Employment impacts sensitivity analysis

Impact on income

Creation of more than 12 thousand direct, indirect and induced employment person-years during the construction period will temporarily increase affected households' income to the value of R1 173.2 million in 2011 prices. Slightly more than five percent of this amount will be localised within the //Khara Hais municipality and a similar amount in the rest of the Northern Cape Province. Thus almost nine out of every ten Rand to be earned by households as a result of construction activities will be distributed amongst households located in various regions of South Africa. Average earnings of the households benefitting from the project through various multiplier effects will equate to about R8 034 per month for an entire year.

Table 6-8: Income changes during construction – high rod scenario (R'ml, 2011 prices)

Year	Direct	Indirect	Induced	Total	% share
Local economy	R 57.0	R 5.8	R 2.7	R 65.4	5.6%
Rest of the Northern Cape	R 0.0	R 42.1	R 19.5	R 61.6	5.2%
Rest of SA	R 179.9	R 446.9	R 419.4	R 1 046.2	89.2%
Total in SA	R 236.9	R 494.8	R 441.5	R 1 173.2	100.0%

High Road scenario encompasses the biggest generation of disposable income. Other scenarios are associated with 12% to 38% lower income earnings by affected households than the High Road scenario. Lower income means lower consumer spending, which in turn translates into smaller induced effects and employment person-years created as a result.

Ultimately, it also means that a smaller number of households are being able to improve their standard of living albeit for a limited time.

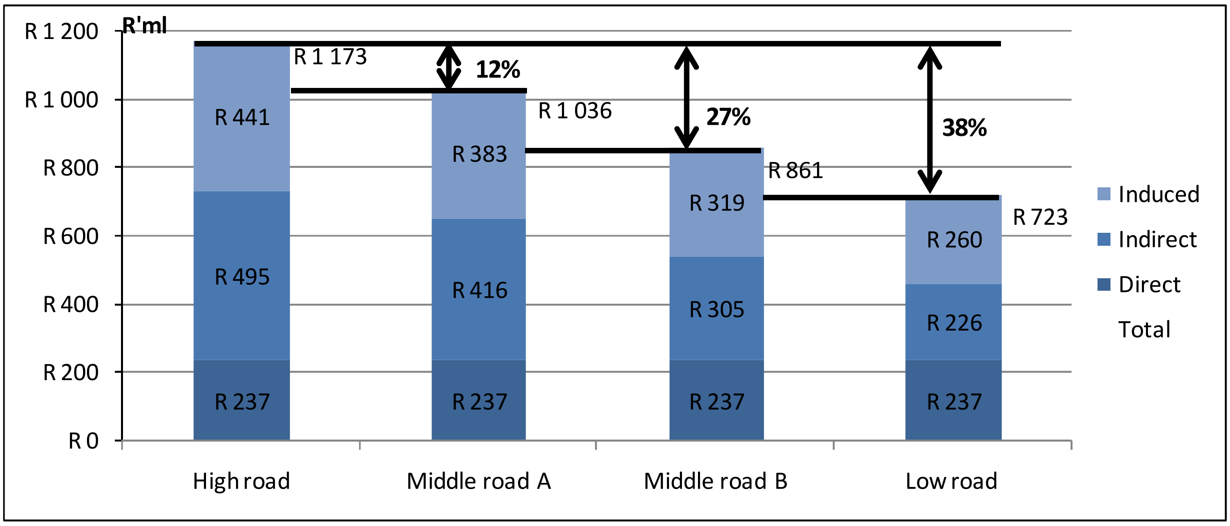


Figure 6-6: Impact on earnings sensitivity analysis (R'ml, 2011 prices)

6.2 Economic impacts during operations

The following paragraphs describe the impact of the proposed facility during the operational period. Assessment covers effects on production, GDP-R, employment and income. Since the facility will be in operation for at least 25 years, economic impacts stimulated by the project and observed during that time are considered to be sustainable. Sustainability is an integral component of the continuous growth and development of any economy, as it ensures retention and possibly even the growth of standard of living of affected people and their households.

Impact on production

Once full operational capacity is achieved, Solar 1 will generate about 483.6 GWh of electricity per annum, which will earn the facility about R251.4 million of revenue in 2011 tariff rates. This revenue represents the business sales that the facility will incur on an annual basis throughout the entire period of operations.

In order to ensure continuous operations of Solar 1, R79.8 million (2011 prices) will be spent on the procurement of goods and services as well as on labour. This expenditure will generate a round of multiplier effects that will result in the increase of production activities all over the country. As indicated in Table 6-9, besides the direct new business sales generated by the facility itself, an additional R138 million of output in 2011 prices will be created elsewhere in the country. Of this amount, the greater portion will be created outside the Northern Cape Province.

Table 6-9: Impact on production during operations (R'ml, current prices)

Year	Direct	Indirect	Induced	Total	% share
Local economy	R 96.5	R 0.4	R 1.6	R 98.6	25.3%

Year	Direct	Indirect	Induced	Total	% share
Rest of the Northern Cape	R 0.0	R 2.9	R 13.5	R 16.4	4.2%
Rest of SA	R 154.9	R 71.6	R 47.9	R 274.4	70.5%
Total in SA	**R 251.4**	**R 74.9**	**R 63.0**	**R 389.4**	**100.0%**

Impacts on production during the operational period will be spread throughout the country, with about a quarter of it being generated in the local municipality and more than 70% in the rest of the country. Furthermore, expenditure to sustain operations of the plant is relatively small, compared to the expenditure required to establish the facility, and significantly smaller than the expected turnover. As a result, the indirect and induced effects stimulated by spending on operations are not expected to be of significant amount.

Impact on GDP-R

Solar 1 is expected to generate R251.9 million of value added (2011 prices) per annum. Of this, R192.4 million will be created directly by the facility itself, whilst the rest will be stimulated through the indirect and induced effects.

Table 6-10: Impact on GDP-R during operations (R'ml, 2011 prices)

Year	Direct	Indirect	Induced	Total	% share
Local economy	R 37.4	R 0.2	R 0.7	R 38.3	15.2%
Rest of the Northern Cape	R 0.0	R 1.1	R 5.8	R 7.0	2.8%
Rest of SA	R 154.9	R 30.5	R 21.2	R 206.6	82.0%
Total in SA	**R 192.4**	**R 31.8**	**R 27.7**	**R 251.9**	**100.0%**

Due to the fact that the proposed facility forms part of Eskom, most of gross operating surplus to be generated by that facility will be accounted at the headquarters of the parastatal. Thus, the increase in value added of the local municipality will account for a small share of the total value added to be created by the facility. Nevertheless, even the relatively small estimated value added to be retained in the LM will increase the size of //Khara Hais by 0.8%. The total positive effects on the provincial economy could amount to 0.09% of its GDP-R. Growth stimulation in the entire country once the facility is in operation will equate to about 0.01% of the national GDP-R

Table 6-11: GDP-R impact on the affected economies

Economy	2011 (R'ml, 2011 prices)	Annual impact (R'ml, 2011 prices)	Change
Local economy	4 795.9	R 38.3	0.8%
Northern Cape	53 222.0	R 45.3	0.09%
South Africa	2 637 800.7	R 251.9	0.01%

Most of the value added to be stimulated by operations of Solar 1 will be created in the utilities sector, as outlined in Table 6-12. Moreover, given the spatial distribution of effects the //Khara Hais utilities sector alone is expected to grow by R38.3 million, which will increase the size of that sector in the local economy by 13% and overall contribution of utilities from 6.6% to 7.3%. Thus, the proposed facility is expected to slightly change the structure of the local economy. With respect to the distribution of effects in the rest of the province and the rest of the country, economic sectors that will experience the largest increase in their GDP-R will include, aside from utilities, manufacturing, finance services, trade, and business services.

Table 6-12: Sectoral and spatial distribution of GDP-R during operations (R'ml, 2011 prices)

Economic sector	Local economy	Rest of Northern Cape	Rest of SA	Total in SA
Agriculture	R 0.0	R 0.3	R 1.0	R 1.4
Mining	R 0.0	R 0.1	R 1.2	R 1.3
Manufacturing	R 0.0	R 0.4	R 11.3	R 11.8
Utilities	R 37.5	R 0.5	R 156.1	R 194.1
Construction	R 0.0	R 0.1	R 0.3	R 0.4
Trade and accommodation	R 0.1	R 0.9	R 7.0	R 8.0
Transport	R 0.2	R 1.2	R 4.4	R 5.8
Financing	R 0.3	R 1.5	R 16.6	R 18.4
Business services	R 0.0	R 0.1	R 5.4	R 5.5
Services	R 0.2	R 1.8	R 3.2	R 5.1
Total	**R 38.3**	**R 7.0**	**R 206.6**	**R 251.9**

Impact on employment

Solar 1 will permanently employ 72 people, the majority of who will be skilled and highly skilled professionals. Most of these employment positions will need to be filled by people coming from outside the local municipality, as job descriptions for the majority of positions requires specialised expertise and knowledge that are unlikely to be found within the economy dominated by tertiary sector and agriculture. This means that some 50 people might re-locate to the //Khara Hails LM and nearby areas.

In addition to the direct employment opportunities created by the facility, 256 FTE jobs will be created through indirect and induced effects. This number is small compared to the number of FTE jobs to be created during construction. Nevertheless, the former are long-term jobs and ensure that affected households have sustainable income over a period of 25 years.

Table 6-13: Impact on employment during operations

Year	Direct	Indirect	Induced	Total	% share
Local economy	72	1	4	77	23.6%
Rest of the Northern Cape	-	5	31	36	11.0%
Rest of SA	-	113	102	214	65.4%
Total in SA	**72**	**118**	**138**	**328**	**100.0%**

Spatial distribution of FTE jobs to be created during operations will largely be skewed towards the rest of South Africa, as the majority of goods and services that will be required to operate and maintain the facility and that will be produced in response to the increased consumer spending will also be spent in the rest of the country. Economic sectors that will experience the largest need to create new employment opportunities in this instance will include, inter alia:

- Manufacturing, in particular chemical products industry, textile and clothing industry, and machinery and equipment industry
- Financing services, in particular insurance
- Trade and accommodation

The potential for new employment to be created in the local municipality and the rest of the province aside from the employment created at the plant is small compared to the number of jobs that can be created in the rest of the country. As indicated in the table below, about 40 additional employment opportunities will be created in the province, inclusive of the local economy, most of which will be created in the trade, agricultural, and manufacturing sectors. All of these employment opportunities will be sustained through the project for the entire duration of its operational life.

Table 6-14: Sectoral and spatial distribution of employment created during operations

Economic sector	Local economy	Rest of Northern Cape	Rest of SA	Total in SA
Agriculture	1	5	21	26
Mining	0	0	6	6
Manufacturing	1	4	51	55
Utilities	72	1	3	76
Construction	0	1	6	8
Trade and accommodation	1	8	38	48
Transport	0	3	12	15
Financing	0	2	47	49
Business services	0	1	17	18
Services	1	12	14	28
Total	**77**	**36**	**214**	**328**

Impact on income

Operations of Solar 1 will generate R47.5 million of household income on an annual basis. Slightly less than half of this will be earned on an annual basis by households (existing or those that will be re-locating) in the //Khara Hais municipality. The rest will largely be earned by households located in the rest of the country, and only a small percentage will be distributed between households in the rest of the Northern Cape. The majority of income generated through indirect and induced effects will be earned by employees of economic sectors such as financing, manufacturing, and community services.

Table 6-15: Impact on income during operations (R'ml, 2011 prices)

Year	Direct	Indirect	Induced	Total	% share
Local economy	R 20.7	R 0.1	R 0.4	R 21.2	44.5%
Rest of the Northern Cape	R 0.0	R 0.5	R 2.8	R 3.3	6.8%
Rest of SA	R 0.0	R 13.7	R 9.4	R 23.1	48.6%
Total in SA	**R 20.7**	**R 14.3**	**R 12.6**	**R 47.5**	**100.0%**

6.3 Strategic benefits of the project

Based on the information presented earlier in this chapter and the understanding of the current policy environment, the proposed project is believed to be of a notable importance for the sustainable development of the national economy.

Contribution towards diversification of generation capacities

Diversifying the electricity generation mix in the country is one of the key directives set by the South African government for the next couple of decades. According to the IRP (2011), the share of renewables in the total generation mix in the country needs to grow from 0% in 2010 to 9% in 2030. Most of this will need to be achieved through the establishment of wind and PV facilities in South Africa. Despite a relatively small allocation of new build capacity towards CSP, the importance thereof should not be underestimated.

The proposed facility will have a nameplate capacity of 100 MW and given the IRP (2011) allocations towards CSP it could be one out of approximately twelve CSP projects established in the country in the next twenty years. CSP technology offers significant advantages over the wind and PV facilities as it carries greater capacity factors than wind farms and allow for generation of electricity during night time unlike PV facilities. CSP plants with storage or hybridisation can also be used for peaking or intermediate loads, which makes them a viable alternative to power plants with conventional technologies. However, CSP technology costs and particularly storage costs are still high at the moment, which prevents it from being a prominent competitor of a conventional coal-powered plant. In the next couple of decades, though, accelerated roll out of CSP facilities all over the world is expected to drive the costs down.

Reduced dependency on fossil fuels and hedging against sharp electricity tariff increases

South Africa's electricity generation is entirely dependent on access to fossil fuels, such as coal. Although the country has an abundance of coal reserves, the prices of extracting this resource is continuously growing resulting in the increase of operating budgets of power stations, which is then recovered from the consumer by means of electricity tariff hikes. In 2010, the NERSA has approved between 24.8% and 25.9% annual increase in electricity tariff increase for a three year period, which means that electricity users would pay about 97% more in 2013 for electricity than in 2010. Renewable energy technologies, such as the proposed Solar 1, do not pay for the energy source. This means that its operating expenditure does not fluctuate with the changes in the inputs costs and largely stays the same over the entire operating period. Thus, whilst cost of producing electricity using fossil fuels such as coal would grow over time, the proposed CSP facility is a fixed-cost generation plant. This means that over time the cost of producing electricity by the CSP facility will remain largely unchanged, which offers a physical hedge against the fluctuating cost of electricity produced by conventional coal-powered plants. It also means that the more electricity generated using renewable energy sources, the greater potential exists in reducing electricity tariff increases over time.

Increase efficiencies of the transmission network

Most of electricity generating facilities in the country are located in and around the Mpumalanga Province. At the same time, the transmission network spans throughout the entire country and due to its stretch, the losses along the transmission line are increased with the growth of the distance from the electricity generation centres. Establishment of Solar 1 in the Northern Cape would improve the efficiency of the national grids and reduce losses over the network.

Contribution towards limiting South Africa's carbon footprint

In 2009, during the Copenhagen climate negotiations South Africa announced that it would volunteer to reduce domestic Green House Gas (GHG) emissions by 34% by 2020 and by 42% by 2025 below the "business as usual" baseline, subject to the availability of adequate financial, technological and other support. The commitment to reduce emissions is also iterated in the NGPF, the latest IPAP. Limiting GHG emissions from the electricity generating industry is also implicit to the IRP (2011) that set emission constrains of 275 million tons per annum after 2024.

The proposed facility will be generating about 483.6 GWh of electricity per annum. Considering an average emission factor for the country of 1.015 kg per kWh (Energy Research Centre, 2007), the proposed facility offers savings of 490 805 tons of CO_2-equivalent per annum. This equates to a saving of about 0.17% of the targeted emission constraint.

Development of the green economy and green jobs

The NGPF is a strategy established by government to, firstly, tackle the issue of unemployment via the creation of decent employment opportunities by supporting labour-intensive sectors and secondly, to ensure long-term growth through the support of capital-intensive and knowledge-intensive sectors. Key sectors with great potential to stimulate job creation have been prioritised and are expected to create the bulk of the five million jobs targeted over the next decade. Most recent data indicate that greening the economy has the potential to create 225 000 between 2013 and 2017 and 460 000 new direct jobs by 2050 (DBSA, 2011). Of these, electricity generation value chain could create 13.8% (31 050 jobs) in the short-term and 28.1% (129 260 jobs) in the long-term.

Realisation of opportunities that lie in the green economy are possible to achieve but only under the condition of continuous learning, knowledge transfer, and co-ordinated efforts to achieve economies of scale. In the emerging industries, investment in Research and Development as well as demonstration projects play a prominent role in creating the environment conducive for roll out of numerous similar projects.

The latest IPAP (2011/12 - 2013/14) stated that the future of CSP in the country is dependent on securing the long-term demand for such an industry and, most importantly, successfully demonstrating the technology at scale and with high levels of performance.

Central receiver and molten salt technologies planned to be applied in the proposed facility, or other solar thermal projects for that matter, have not yet been established in the country. Although a number of research projects are being conducted by research institutions and universities in South Africa, the country cannot yet compete with countries such as Spain, Germany, and the USA in terms of skills, knowledge, and local manufacturing capabilities. The proposed project, though, is the first steps towards the establishment of such capabilities as it would grow the country's knowledge of CSP and provide valuable lessons in construction, manufacturing, operation, and maintenance of solar thermal systems that could be carried over in other projects in the country and possibly abroad.

Success in operation and achieving high efficiencies at Solar 1 could contribute to the broader roll out of similar facilities in South Africa. This would create sufficient demand to achieve economies of scale in production and manufacturing processes of required CSP components, in particular mirrors, steel structures, electronics, and components that require undergoing specialised processing.

CHAPTER 7. KEY FINDINGS AND RECOMMENDATIONS

The purpose of this study was to assess the economic impact on the national and local economy resulting from the establishment of the proposed 100 MW CSP facility (Solar 1) near Upington, Northern Cape. The primary focus of the assessment was on determining the potential to localise the expenditure on construction and operation of Solar 1 and effects thereof on production, GDP-R, employment, and income. Given the uncertainties in procuring certain inputs from within the country (more specifically mirrors and steel structures), four possible scenarios were developed and modelled. This assisted in determining the sensitivity of potential economic impacts to the possible localisation scenarios. The key findings of the study can be summarised as follows:

- Current policy environment of government puts a significant emphasis on the need to diversify electricity generation by means of including renewable energy sources alternatives. This is seen as the means to achieve environmental, social and economic imperatives of the country that include reduction of carbon footprint of South Africa, decreasing levels of unemployment and poverty, and stimulating economic development.
- The proposed project is to be located in the //Khara Hais LM that largely comprises of the tertiary sector and whose dynamics are quite sensitive to the changes in the local climatic conditions due to the significant agricultural activities that take place in the area. The economy of the local municipality is vibrant and encompasses numerous opportunities in transportation, agriculture and agro-processing, hospitality industry, and utilities.
- The proposed Solar 1 will have a nameplate capacity of 100 MW and make use of a central receiver and molten salt technologies that have not yet been widely applied globally and have not yet been tested on such a large scale. Many of the components required for construction of the CSP facility are elements that can be produced from local industries; some though require access to know-how and specialised knowledge, processes, or raw materials which limits the possibility of localisation. The latter especially relevant to the central receiver, steam turbine generator, mirrors, steel structures and molten salt. Whilst procurement of central receiver technology, generator and molten salt in the country is not feasible at this stage, manufacturing of mirrors and steel structures is viable. This, though, is subject to certain conditions such as economies of scale and the price of steel, which make localisation uncertain.
- The establishment costs of Solar 1 are estimated to be R4 844.3 million (2011 prices). If it is assumed that mirrors and steel structures can be procured within the country, local expenditure will amount to R2 637 million or 54%. In the opposite scenario (no mirrors and main steel structures) only a third of the project's expenditure could be retained in the country.

- Investment in the CSP facility is associated with a notable return to the national and local economies in the case of the most optimistic scenario (i.e. High Road):
    - For every R1 to be spent in South Africa R3 is created in new business sales, R0.99 is created in value added, 4.7 generated employment person years, and R0.44 is earned in income.
    - In total, R2 624.8 million of value added and 12 164 employment person years will be created in the country during construction.
- In the cases, when mirrors, steel structures or both cannot be procured from within the country, the unrealised opportunities are significant:
    - In the case of imported mirrors, R329 million of value added, 1 934 employment person-years, and R138 million of household earnings could potentially be unrealised
    - In the case of imported steel structures, R651 million of value added, 3 056 employment person-years, and R312 million of household earnings could potentially be unrealised
    - In the cost of imported mirrors and steel structures, R979 million of value added, 4 990 employment person-years, and R450 million of household earnings could potentially be unrealised
- Local economy is also expected to benefit from the construction of the proposed plant. Due to the composition of the local economy, these opportunities will largely be realised in the construction sectors, with small benefits extending towards local transport and mining sectors. Overall, 2.9% of total value added and 5.9% of employment person-years to be created during construction will be generated within the local economy.
- Solar 1 is a fixed-cost electricity generation facility compared to the conventional coal-powered plants with fluctuating input (coal) prices. It is estimated that about R79.8 million will be spent on maintaining continuous operations of Solar 1, of which R20.7 million will be spent on salaries and wages of 72 permanent employees.
- Operations of Solar 1 will generate production to the value of R389.4 million (2011 prices) per annum and will increase the national economy's GDP-R by R251.9 million per annum. A total of 328 Full-Time-Equivalent jobs will be created in the country, which will result in households' earnings of about R47.5 million per annum.
- The proposed project will also have positive sustainable impacts on the local economy during operations. Aside from the creation of 72 new direct jobs, the local utilities sectors will increase by about 13%, resulting in the slight change of the local economy's structure and size.

Based on the above, it can be concluded that the proposed facility carries numerous economic benefits both for the entire country and the local economy. Aside from this, the facility is also seen as flagship project that would set the scene for knowledge generation and future roll out of similar projects in the country. In order to ensure that potential positive economic effects presented by Solar 1 are fully realised, the following is recommended:

- Procurement of steel structures and steel within South Africa for the proposed facility carries a significant potential for job creation in the country, particularly in the manufacturing industries. Comparatively high steel prices in the country can jeopardise this opportunity. Thus, local industry players will need to be engaged as early as possibly to allow time for negotiations and finding feasible solutions that would ensure procurement of steel and steel structures from South Africa based companies.
- Manufacturing of mirrors also carries notable job creating opportunities that cannot be ignored in the context of the current employment situation. It is most likely that local glass manufacturing companies will be able to produce mirrors for the facility; however, due to the fact that existing companies will need to expand production lines and assurance of quality and durability of the product will take time to attain engagement with these companies should also be seen as a priority. Moreover, due to the requirement for large economies of scale that need to be achieved to make investment in the new production line economically feasible, someone will need to take leadership in coordinating efforts of various developers in the country. This role should ideally be assigned to government.
- In order to maximise the participation of local businesses in the construction and maintenance of the facility, local businesses in //Khara Hais and surrounding areas should be engaged prior the construction activities. Such engagement should be done with the purpose of raising awareness of the types of services that will need to be procured so as to allow the local companies to plan accordingly with respect to skills, capacities and logistics.
- Potential to find suitable candidates for filling permanent positions at the plant during its operations within the local municipality is limited. In order to minimise workers migration and optimise the number of jobs created in the local community, screening of local labour for potential employees of the plant need to be conducted as soon as possible. Most promising candidates then should be sent for training and internships to ensure their competence by the time the plant starts operating.

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ANNEXURE A: CONSTRUCTION COST BREAKDOWN ASSUMPTIONS

	Project cost (US$=R7.39)			Split between labour and material costs		Localisation in SA		Local economy localisation		Labour		
Construction items	% split	US$'ml	R'ml	Labour	Material	Labour	Material	Labour	Material	Skill level	Salary pa	Number
Structures and improvements	0.3%	1.8	13.6									
Control room	*1%*	*0.0*	*0.2*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*43%*	*Skilled*	*120 361*	*0*
Visitor's centre	*4%*	*0.1*	*0.6*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*43%*	*Skilled*	*120 361*	*1*
Fencing	*34%*	*0.6*	*4.7*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*0%*	*Semiskilled*	*76 000*	*12*
Security office	*0%*	*0.0*	*0.1*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*43%*	*Skilled*	*120 361*	*0*
Heliostat assembly facility	*51%*	*0.9*	*6.9*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*10%*	*Skilled*	*120 361*	*11*
Admin building	*7%*	*0.1*	*0.9*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*43%*	*Skilled*	*120 361*	*1*
Parking area	*2%*	*0.0*	*0.2*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*90%*	*Semiskilled*	*76 000*	*1*
Heliostats	30.8%	204.3	1 509.5									
Mirrors	*20%*	*40.9*	*301.9*	*0.0%*	*100%*	*0%*	*100%*	*0%*	*0%*	*Skilled*	*120 361*	*-*
Axis (metal support structured)	*70%*	*143.0*	*1 056.7*	*0.4%*	*100%*	*100%*	*50%*	*0%*	*0%*	*Skilled*	*120 361*	*35*
Electrical component	*9%*	*18.4*	*135.9*	*15.0%*	*85%*	*100%*	*0%*	*0%*	*0%*	*Skilled*	*120 361*	*169*
Foundation	*1%*	*2.0*	*15.1*	*19.0%*	*81%*	*100%*	*100%*	*100%*	*50%*	*Semiskilled*	*76 000*	*38*
Central receiver/tower	17.1%	113.4	837.9									
Tower	*12%*	*14.1*	*103.9*	*7.0%*	*93%*	*100%*	*100%*	*100%*	*43%*	*Skilled*	*120 361*	*60*
Receiver	*88%*	*99.3*	*734.0*	*1.0%*	*99%*	*100%*	*0%*	*0%*	*0%*	*Skilled*	*120 361*	*61*
Working fluid (molten salt)	4.4%	28.9	213.6	0.2%	100%	100%	0%	0%	0%	Skilled	120 361	4
Thermal energy storage and heat transfe	4.2%	28.1	207.7									
Storage tanks	*34%*	*9.4*	*69.7*	*0.5%*	*100%*	*100%*	*42%*	*0%*	*0%*	*Skilled*	*120 361*	*3*
Foundation	*12%*	*3.3*	*24.6*	*7.0%*	*93%*	*100%*	*100%*	*100%*	*50%*	*Skilled*	*120 361*	*14*
Insulation	*3%*	*0.9*	*6.8*	*0.5%*	*100%*	*100%*	*100%*	*0%*	*0%*	*Skilled*	*120 361*	*0*
Heat exchangers	*26%*	*7.2*	*53.3*	*0.5%*	*100%*	*100%*	*0%*	*0%*	*0%*	*Skilled*	*120 361*	*2*
Pumps	*8%*	*2.2*	*16.4*	*0.5%*	*100%*	*100%*	*0%*	*0%*	*0%*	*Skilled*	*120 361*	*1*
Balance of the system	*18%*	*5.0*	*36.9*	*0.5%*	*100%*	*100%*	*0%*	*0%*	*0%*	*Skilled*	*120 361*	*2*
Power block facility	15.5%	103.1	761.7	5.0%	95%	100%	12%	100%	12%	Skilled	120 361	
Main steam turbine	*19%*	20.0	*147.8*	0.0%	*100%*	100%	0%	0%	0%	Skilled	120 361	-
Condenser	*25%*	25.4	*187.4*	0.0%	*100%*	100%	100%	0%	0%	Skilled	120 361	-
Feed Heaters	*25%*	25.7	*189.7*	0.0%	*100%*	100%	100%	0%	0%	Skilled	120 361	-
Pumps	*9%*	9.4	*69.3*	0.0%	*100%*	100%	100%	0%	0%	Skilled	120 361	-
Pipes, Fittings and Vessels	*9%*	9.2	*67.8*	0.0%	*100%*	100%	50%	0%	0%	Skilled	120 361	-
Electrical, Control & Instrumentation	*4%*	4.2	*31.2*	0.0%	*100%*	100%	30%	0%	0%	Skilled	120 361	-
Civil & Structural	*9%*	9.3	*68.6*	19.0%	*81%*	100%	100%	100%	50%	Skilled	120 361	108
Balance of plant	8.5%	56.2	415.5									
Heat exchangers	*35%*	*19.7*	*145.4*	*5.0%*	*95%*	*100%*	*100%*	*0%*	*0%*	*Skilled*	*120 361*	*60*
Piping and cabling	*35%*	*19.7*	*145.4*	*20.0%*	*80%*	*100%*	*100%*	*0%*	*0%*	*Skilled*	*120 361*	*242*
Electrical component	*15%*	*8.4*	*62.3*	*15.0%*	*85%*	*100%*	*0%*	*0%*	*0%*	*Skilled*	*120 361*	*78*
Water treatment	*10%*	*5.6*	*41.5*	*5.0%*	*95%*	*100%*	*100%*	*0%*	*0%*	*Skilled*	*120 361*	*17*
Chemicals	*5%*	*2.8*	*20.8*	*0.0%*	*100%*	*0%*	*100%*	*0%*	*0%*	*Skilled*	*120 361*	*-*
Site work and infrastructure	3.6%	23.8	175.9									
Civil works	*89%*	*21.3*	*157.1*	*18.7%*	*81%*	*100%*	*100%*	*90%*	*50%*	*Semiskilled*	*120 361*	*244*
Roads	*11%*	*2.5*	*18.7*	*18.7%*	*81%*	*100%*	*100%*	*90%*	*50%*	*Semiskilled*	*120 361*	*29*
Project design and management	6.5%	43.1	318.5	100.0%	0%	30%	0%	0%	0%	Highly skilled	860 000	111
Grid connection	1.1%	7.5						0%	0%			
Transport costs	1.7%	11.1	81.7	0.0%	100%	0%	100%	0%	50%	Skilled	120 361	-
EPC mark-up	6%	41.8	308.7		100%		100%		0%			
Total		*663.0*	*4 844.3*	*100%*								*1 304*