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Abbreviations and Acronyms

- BA  Basic Assessment
- CPV  Concentrated Photovoltaic
- DEA  National Department of Environmental Affairs
- DAFF  Department of Agriculture, Forestry & Fisheries
- DWA  Department of Water Affairs
- EA  Environmental Authorisation
- EAP  Environmental Assessment Practitioner
- EIA  Environmental Impact Assessment
- EMP  Environmental Management Plan
- IPP  Independent Power Producer
- IPPPP  Independent Power Producer Procurement Programme
- PPA  Power Purchase Agreement
- MTS  Main Transmission System
- NEMA  National Environmental Management Act
- NERSA  National Energy Regulator of South Africa
- PV  Photovoltaic
- REIPPPP  Renewable Energy Independent Power Producer Procurement Programme
- SID  Strategically Important Development
- SANRAL  South African National Roads Agency Limited
- UNFCCC  United Nations Framework Convention on Climate Change
1 Introduction

RE Capital 11 (Pty) Ltd. Solar Energy Facility, as an Independent Power Producer (IPP), is proposing the establishment of a commercial solar energy facility on a site within the Northern Cape to be known as RE Capital 11 (Pty) Ltd. Solar Energy Facility. The project is planned to be located on the Remainder of Farm 454, Dyason’s Klip with a planned installed electrical capacity of 75 MWp.

The Northern Cape is generally known to be one of the best preferred areas for the generation of solar energy in South Africa and even in the world because of abundant solar radiation. The purpose of this facility is to generate electricity from a renewable energy source (i.e. solar radiation) to provide power to the national electricity grid. The proposed development site is located within the Khai Garib Municipality district approximately 25 km west of Upington.

The purpose of this engineering report is to describe the various sections of the facility and provide a transparent view on facility operation and the possible effects on the environment. Solek, a renewable energy engineering company, is primarily responsible for the compilation of this section of the report – a complete company profile is attached in the appendix for the reader’s convenience and perusal.

The report gives background on the energy market in South Africa and the opportunity for solar energy in the Northern Cape. The overall project and proposed facility is also described in more detail by investigating:

- High-level overview of the South African energy sector
- The basic understanding of solar PV plants
- The description of the proposed solar facility
- The different steps in the construction phase of the proposed facility
- The project operation and maintenance phase
- Financial implications and financial overview
- Planned project timelines
- Overall conclusion

1.1 Background of the energy market in South Africa

The development of renewable energy in South Africa is gaining momentum as the first 3 rounds of REIPPPP projects have been awarded and construction of PV, CPV, CSP and Wind Energy projects are in progress. The established “Renewable Energy Independent Power Producers Program” (REIPPPP) is widely and internationally regarded as a very successful program for the realisation of renewable energy projects, by the private sector. The development of the renewable energy sector is seen as one of the key development areas and industries within South Africa. In addition, the security of energy supply and sustainability thereof is seen as critical and strategic importance by the South African government.

According to the governmental developed twenty year energy plan for South Africa, Integrated Resource Plan 2010 (IRP 2010-2030), South Africa is expected to require 42 500 MW of additional energy over the following 20 years in order to meet the requirements created by the growing economy.

The Renewable Energy Independent Power Producers Programme initially made 3725 MW of power available to be generated as part of a first phase initiative for renewable energy projects, aimed to be online by 2015. In December 2012 the Department of Energy announced a further 3200 MW of
renewable energy aimed to be online by 2020. The first three bidding windows have taken up 3916 MW of this target, equating to a remaining 2808MW. The Department of Energy (DoE) has set a number of dates for the submission of bid documents for private companies to apply for a licence to generate electricity. The bidding deadlines for the first three stages were as follow:

- 1st Bid Submission: 4 November 2011
- 2nd Bid Submission: 5 March 2012
- 3rd Bid Submission: 19 August 2013
- 4th Bid Submission: 18 August 2014
- 5th Bid Submission: August 2015 (not confirmed)

The 5th Bid submission dates have not been confirmed but was initially expected for August 2015, although there has been some speculation of accelerated timelines for Round 5 submission dates. The RE Capital 11 Solar project intends to form part of the 5th bid submission.

1.2 Opportunity for solar energy in the Northern Cape

When considering South Africa’s irradiation distribution, the Northern Cape Province is known to be one of the most preferred areas for the generation of solar energy in South Africa and even in the world. This can be ascribed to the advantageous sun radiation specifications and the vast flat planes that the province has to offer which are not intensively used except for grazing. The global irradiation in the specific area is between 2400 and 2600 kWh/m². Furthermore, specific parts of the Northern Cape can be used for the generation of power without compromising on food security due to the area’s low food produce capacity per hectare of usable land. Below is a map which gives an overview of this potential.

![Figure 1: South African solar irradiation distribution](image_url)
The benefits that the production of energy from the sun holds within the broader South African context outweigh most potential negative impacts the development may have on the bio-physical environment of the property. The contribution and agricultural value of the specific farm should be compared to the impact the national energy crisis could have. This crisis effects job creation, skills development and economic growth potential of the renewable industry.

On the economic front, the proposed project has the potential of making a significantly positive contribution to the local economy. The Northern Cape was well-known for the large number of copper and zinc mines in the area, but since the early 1990s, many of these mines have closed down, leaving a devastating trail of unemployment behind. The local economy, mainly supported by farming, is simply not enough to accommodate the high level of unemployment. In addition, social problems imposed by poverty create a problem in the surrounding area. The proposed development has the opportunity to create a significant amount of career opportunities over its entire lifespan of 20-30 years.

An additional benefit for the area along the Orange River and its corresponding solar development potential is that of energy consumption seasonality. In summer time the peak demand for electricity is in the afternoon (sun shine hours) due to irrigation in the agricultural sector, especially vineyard culture, effectively providing a good natural fit towards load and generation time of usage/generation.

### 1.3 Overview of the proposed project

The applicant is proposing the establishment of a commercial solar energy facility, known as the RE Capital 11 (Pty) Ltd. Solar Energy Facility and will be operated under the licence of a company bearing the same name, RE Capital 11 (Pty) Ltd. Solar Energy Facility. The proposed development site is located on the Remainder of Farm 454, Dyason’s Klip, which is situated within the jurisdiction of the Khai Garib local Municipality in the Northern Cape Province. The purpose of the facility is to assist the government in providing much needed electricity by generating energy from the sun as renewable energy source. The proposed solar development aligns with the planned generation development by the Department of Energy, under the REIPPPP program and the IRP 2010 plans.

The proposed facility is planned and designed for the generation of approximately 75 MW. The developed electricity of this project will be fed into the national electricity grid. The proposed development site covers an area of approximately 240 hectares, although an initial preliminary study site of 510ha been selected for consideration by participating specialists. The area is located approximately 10.5 km from the planned new Eskom Upington MTS substation, on the authorised location based on the Remainder of Farm 644, Olyvenhoutsdrift. The EIA for the new MTS was done independently by Eskom and was authorised on the 14th of February 2014.

### 2 Solar energy as a power generation technology

#### 2.1 Basic understanding of solar PV plants

Photovoltaic (PV) panels convert the energy delivered by the sun to direct current (DC) electric energy. The array of panels is connected to an inverter by means of a network of cables. The DC power is inverted to alternating current (AC) power by a grid-tied inverter. The AC power can then
be added to the national electricity network (grid). The voltage at which power is generated is stepped up to the required voltage and frequency of the national grid by using a transformer. The electricity is distributed from the on-site transformers via distribution lines to the nearest Eskom substation. From the Eskom substation the electricity is fed into the Eskom grid.

![Figure 2: Typical solar PV plant diagram](image)

The infrastructure of the facility includes the ground-mounted structures, panels, cables, inverter rooms, access roads, auxiliary roads, an on-site substation, and a distribution line. The primary input of the system is sunlight, which is converted to electricity. In the case of sun tracker technology the facility may also utilise auxiliary electricity from the Eskom grid to power tracker motors in order to optimise the amount of sunlight on the solar PV infrastructure. In addition to auxiliary power being used for powering tracker motors, small amounts of auxiliary power would be used for on-site usage on items such as, but not limited to, security and site office energy requirements.

Installing either a fixed or dual tracking PV system (CPV modules or arrays of PV panels) is proposed. In a fixed system, the PV modules stay in one position, and do not follow the path of the sun. A tracking system is ground-mounted and follows the sun’s path with the use of typically single or dual-axis technology in order to maximise the amount of direct sunlight on the Solar PV modules. By following the sun, the tracked array rises quickly to full power and stays there on a clear sunny day, while the fixed array only maintains maximum power for a few hours in the middle of the day.

2.2 Project-related benefits

The single largest benefit of the generation of solar energy is the fact that the electricity is generated by means of a renewable source, the sun. This contributes toward sustainability and renewable energy. In essence the energy source cannot become depleted as in the case with fossil fuels (i.e. coal or oil). This type of energy production does not pollute the environment – it is renewable, reliable and does not consume anything close to the amount of natural resources as compared to conventional power generation (e.g. coal power plants). Its long-term environmental benefits are perhaps the most notable of any electricity source. These benefits hold much promise for reducing environmental impacts from electricity production of coal power plants – which is the most common technology used in South Africa.
The production of 75 MWp alternative energy is a welcomed supplement to the electricity supply of South Africa and aligns with the targets set by government for reduction of fossil fuel reliance and fossil fuel based electricity. The renewable energy projects are treated as “Strategically Important Developments” (SID’s) under the IPP Procurement Programmes, since these projects have the potential to make a significant contribution to the national and local economy.

Not only will the project contribute to the existing electricity grid of Eskom in the area, but also in achieving the 40% share of new power generation being produced by IPPs nationally.

Long-term benefits, particularly related to the local community and society, can be realised through the project, mainly in terms of much needed employment and skills development. Such a project is a very good stimulus for the local and national economy, positively contributing especially to the surrounding community. In addition, the general requirements provided for by government stipulate strong local procurements and local investments into the surrounding communities.

3 Description of the proposed solar facility

The proposed facility has a planned peak capacity of be 75 MWp, with an estimated footprint between 200 and 240ha. The initial study area of 510ha is included within for the environmental specialists area. The footprint in the EIA is larger than what is physically required for the proposed development, so as to ensure ample development space are available after potential environmental sensitive areas are excluded, as a function of specialist studies and recommendations. The estimated portion of land each component of the facility will typically occupy is summarised in the table below (with the average area per phase taken as 200ha):

Table 1: Component size and percentage for the proposed 75MWp

<table>
<thead>
<tr>
<th>Component</th>
<th>Estimated extent of 75 MW plant</th>
<th>Percentage of selected area (+ 200 ha)</th>
<th>Percentage of whole farm (+5725 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV or CPV modules</td>
<td>180 ha (1.8 km²)</td>
<td>90%</td>
<td>3%</td>
</tr>
<tr>
<td>Internal roads-6m width</td>
<td>18 ha (0.27 km²)</td>
<td>9%</td>
<td>0.31%</td>
</tr>
<tr>
<td>Auxiliary buildings</td>
<td>2 ha (0.02 km²)</td>
<td>1%</td>
<td>less than 0.1%</td>
</tr>
</tbody>
</table>

The proposed infrastructures that are planned to be constructed include a series of solar PV modules (either constructed in conventional PV arrays or as loose standing CPV modules –both referred to as PV technology), inverters, internal electrical reticulation and an internal road network. An on-site substation will need to be constructed - this will typically include a transformer to allow the generated power to be connected to Eskom’s electricity grid. Auxiliary buildings, including ablution, workshops, storage areas and fencing, are planned to be erected. A distribution line will also be required to distribute the generated electricity from the site to the existing power lines and/or Eskom substation.
3.1 Site development components
The final design will consist of different components. A typical description of the components and their assumed impact are listed below. For more detail on the preliminary layout, please refer to the Layout Report.

**Position of solar facilities**

The exact position of the solar PV or CPV module layout will follow a risk-averse approach and be determined by the recommendations in the environmental specialists’ reports in order to avoid all sensitive areas in the positioning of the facility. In addition, the final layout will be influenced by the final detail design of the project once a tender has been awarded (preferred bidder status has been awarded by the Department of Energy to the project). The footprint of the 75 MW will be located on a proposed site area of 240 ha, with a preliminary investigated area of 510 ha by specialists (Remainder of Farm 454, Dyason’s Klip). The final footprint of the facility is expected to be closer to 200 ha, effectively allowing land area to be excluded as sensitive area should this be required.

The following figure depicts a typical layout of PV modules for the two types of PV technology.
1. **Foundation footprint**

The physical footprint of the PV/CPV modules on the ground is formed by a network of vertical poles (typically 100 mm in diameter), on which the modules are to be mounted (see examples below). The following figure depicts the typical foundation and substructures unto which the frames and PV modules are mounted.

![Foundation footprint](image)

Different methods are used to mount the modules to the ground. The mounting structure choice will be influenced by the pricing, geotechnical properties and technology at the time of construction.

Some of the methods include basic drilling or hammering with specific tools. The physical process of ramming the anchors into the ground is done using special equipment (typically on tracks). In the case where earth screws or rock anchors would be more suitable, the rammed pole would be replaced by one of the former. Some of the ground covering in the medium sensitivity area will be cleared to do the frame installation accurately. Although the site is very flat, some minor excavation may be necessary in certain medium sensitivity areas. The modules can also be mounted to the ground in small concrete foundation blocks; usage of concrete foundation will be limited as far as possible (function of geology and other requirements). Removal of such foundations is possible upon de-commissioning of the project.

2. **Module height**

The PV panel arrays have an approximate height of 3.5 m, whereas the CPV modules have a height of 10m. A maximum height of 10 m will be considered and assessed in the Environmental Impact Assessment Process. This will allow for flexibility to technology changes in the industry. The maximum height listed here is only a precautionary description due to foreseeable future changes in technology.
3. **Solar Panel Area**

The solar arrays are put together with strings of solar modules connected in series, which can be mounted onto single or double axis tracking systems. These frames are typically installed with the single tracking axis in an east-west direction to maximise the system’s output. The standardised length of a solar array would typically be between 50 m and 200 m long. Where a tracker system is used, each of the modules is controlled individually and standardised systems are preferred for economic and practical reasons. The solar modules will be placed in such a way that it would have the least influence on the washes and avoiding the ecological boundaries set where practically possible.

4. **Access road to site**

An access road of approximately 6m wide will be required for the facility. The access road alternatives are discussed in more detail later in this report and within the layout report.

5. **Internal roads indication width**

Gravelled internal roads and un-surfaced access tracks are to be provided for. Such access tracks (typically < 6 m wide and limited to the construction site) will form part of the development footprint. Pathways (typically <6 m wide) between the PV/CPV module layout will typically also be provided for to make the cleaning and maintenance of the panels possible. Existing roads will be used as far as possible.

The following figure depicts an example of typical internal roads.

6. **Inverter Rooms**

The DC cabling (LV/MV) from the module strings will be connected to the inverters that will be housed within inverter rooms located at specific areas as per solar PV design layouts and cabling diagrams (these diagrams will be populated closer to tender submission, or post-preferred bidder status). The footprint of an inverter room will be approximately 56m² (4m x 14m) and height of 3m.
7. **On-site substations and transformers**

The step-up substation and its associated infrastructure and internal roads should have a footprint of approximately 0.04 ha (20 m x 20 m). Note that the 0.04 ha is an estimate and included in the entire building footprint of typically < 1 ha.

![Figure 8: Typical on-site substation footprint](image)

8. **Cable routes and trench dimensions**

Shallow trenches for electric cables will be required to connect the PV/CPV modules to the on-site substation (such electric cables are planned along internal roads and/or along pathways between the PV/CPV modules).

![Figure 9: Typical cable trenches](image)

9. **Connection routes to the distribution/transmission network**

Electricity will be transmitted from the on-site step-up substation via a new overhead power line to either the existing 132kV Oasis-line or via an own-built line to the planned Eskom substation (located to the east of the proposed site). A number of possible connection routes are investigated in this EIA. The final preferred route will be subject to the negotiations with the neighbouring farmers and the recommendation of the environmental specialists. Please refer to the layout report for more detailed depiction and description of grid connection route options.
10. **Security fence**

A perimeter security fence will be constructed around the solar park with a guarded security point. The perimeter security fence is envisioned to include security cameras and any related and required infrastructure (such as cabling, central monitoring etc). Note that energy supply towards these required security infrastructure is envisioned to be obtained from the auxiliary power supply.

11. **Cut and fill areas**

As far as possible, any cut and fill activity along the access roads will be avoided. The majority of the proposed access roads are currently being used by construction vehicles and should not need any alternation. Where alternations might be necessary, input from civil construction engineers will be sourced regarding the cut and fill aspects.

12. **Borrow pits**

As far as possible, the creation of borrow pits will also be avoided. There is an old tungsten mine on the Dyason’s Klip farm. There is still a number of old gravel heaps at the mine site. Road surfacing material required (e.g. gravel/base course or stone) can be sourced from these heaps if required. The current EIA application does not make provision for new borrow pits. Should new borrow pits be required on the property, these will have to be licenced/authorised in terms of the Minerals and Petroleum Resources Development Act and the National Environmental Management Act. To avoid this process an existing licenced borrow pit in the area would rather be used.

13. **Soil heaps**

As far as possible, the creation of permanent soil heaps will be avoided. All topsoil removed for the purpose of digging foundations are to be separately stockpiled within the boundaries of the 240 ha development footprint, for later rehabilitation. It is unlikely that major soil heaps will be required for this construction site.

14. **Auxiliary buildings (Laydown area)**

The auxiliary buildings area will typically include:

- A workshop area
- A storeroom area
- A change and ablution room area
- An administrative and security building
- 10 x 10 kl water tanks

![Figure 10: Foundation of a typical on-site building](image)
The infrastructure for the auxiliary buildings should occupy approximately 2 ha. The workshop will be used for general maintenance of parts, etc. and will typically be 20 m x 40 m. The storeroom will be used for the storage of small equipment and parts and will typically be 20 m x 30 m. The change and ablution facilities will be very basic and will include toilets, basins and a change area. The administrative and security building will be used as an on-site office and will have a footprint of typically 10 m x 10 m.

The final detailed design and exact coordinated layout of the facility will be designed and finalised should the facility be approved and awarded a tender as a “preferred bidder” under the REIPPPP. The component list above is typical to such projects and may deviate due to engineering requirements, new technologies and regulatory changes from the government’s tender process. This will be done should the project be approved and the environmental specialists recommendations have been made.

3.2 Project alternatives

In order to propose the best possible design in terms of economic and environmental aspects, several alternatives have been considered. The various alternatives considered in terms of site, layout, technology, and distribution lines are discussed in the following sections.

3.2.1 Site alternatives

As part of the EIA and specialist study area, a larger area has been identified in order to optimise the site and minimise the impact on sensitive areas. The identified area for the proposed PV site is located centrally to the portion of the farm Dyason’s Klip 454. This identified area is also located north of DEA registered Dyasons Klip 1 Project (previously known as RE Capital 3 (Pty) Ltd. project). For more information on the location of the RE Capital 3 projects, please refer to Figure 13. Two site alternatives were investigated on the Dyason’s Klip farm for RE Capital 11 (Pty) Ltd solar PV facility with an initial study area of 510ha. The two sites are located within the same study area adjacent to each other. It was decided to only proceed with one of the proposed sites, as the most suitable site.

3.2.2 Layout alternatives

The actual location of the different facility components on the 510 ha development site may vary. Determining the optimal and detailed layout is a costly process which would normally take place once preferred bidder status has been awarded to the project. Several layout alternatives will, however, be considered. The preferred layout will be determined by taking into account the site constraints identified and recommendations made by the various EIA specialists (within the environmental impact assessment phase).

The actual construction footprint and size of the preferred plant layout will remain the same (200-240ha), but the exact location may change within the 510 ha boundary. Sensitive areas identified by participating specialists will be excluded within the EIR phase of the environmental assessment phase.

3.2.3 Technology alternatives

The proposed development area will make use of Solar PV or Solar CPV technology. The option of constructing a CSP facility is not considered or assessed within this application.
Two technology alternatives for PV solar facilities have also been considered for this application. An overview of the two PV technologies as well as a summary of their advantages and disadvantages is discussed below.

### 3.2.3.1 PV alternative T1: concentrated photovoltaic solar farm (CPV)
CPV technology differs from conventional photovoltaic systems (PV) in that the CPV modules use different solar cells and include lenses which focus light energy in a more concentrated manner, hence harvesting more energy from the sun. The efficiency of the cells provides benefits relating to capacity per module and reduced spatial requirements and usage. CPV technology systems are much higher than conventional PV technology, with the system reaching a maximum height of approximately 10 m. In some cases CPV installations can require a higher amount of water for cooling, unlike PV panels which only require water for cleaning purposes. However, there are alternative dry cooling methods that do not require additional water. By using CPV technology the impact on the environment can be seen as slightly higher mostly in terms of the height of the module, although some parties see this as an environmental advantage. The height of the modules and the fact that the modules are spread wider apart exposed the ground below the modules to more sunlight than conventional PV arrays, which can allow the vegetation to grow back much quicker than with conventional PV.

### PV Alternative T2: Photovoltaic Solar Farm (PV) – the preferred and proposed alternative
Photovoltaic solar power is solar energy that is converted into electricity using photovoltaic solar cells. The captured light moves along a circuit from positive-type semiconductors to negative-type semiconductors in order to create electric voltage. Semiconductors only conduct electricity when exposed to light, as opposed to conductors, which always conduct electricity, and insulators, which never conduct electricity.

Power is collected through a structure comprised of many solar cells, usually a solar power panel (also called a PV module). PV modules/solar panels can be combined into an “array” of panels in order to capture a greater amount of solar energy. PV solar panels can either be fixed (rows of tables) or they can be constructed on a single or double axis tracking system. Such a system will use sun sensors to follow the movements of the sun. With the double axis tracking system the sun can be tracked on more than one axis allowing the maximum radiation over the entire solar module.

The fixed tilt solar technology (table installations of rows) is the less expensive option but it has a much lower energy yield than the axis tracking system (free standing panel installation).
3.2.3.2 Summary of environmental advantages and disadvantages of CPV and PV technology

The following table depicts the different advantages and disadvantages correlated to PV and CPV technology.

Table 2: Technology comparison (CPV and PV) - advantages and disadvantages

<table>
<thead>
<tr>
<th>CPV</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>Takes up less surface area therefore “footprint” is less, resulting in less impact on soil, agriculture and biodiversity.</td>
<td>Higher visual impact, CPV systems can be up to 10 m high.</td>
</tr>
<tr>
<td>More energy can be produced per module.</td>
<td>Higher impact on birds.</td>
</tr>
<tr>
<td>Because the modules are higher and spread out, the ground in between and under the modules are exposed to more sunlight, allowing vegetation to grow back easier after construction.</td>
<td>Higher impact on bats.</td>
</tr>
<tr>
<td></td>
<td>Requires skilled labour because more difficult to erect.</td>
</tr>
<tr>
<td></td>
<td>CPV systems utilises more water than conventional PV.</td>
</tr>
<tr>
<td></td>
<td>Higher cultural/ historic impact to the landscape.</td>
</tr>
<tr>
<td></td>
<td>Harder to transport – abnormal load.</td>
</tr>
<tr>
<td></td>
<td>PV facilities of the same footprint of CPV facilities produce less power.</td>
</tr>
<tr>
<td></td>
<td>The tightly packed PV arrays allow little sunlight through, which can cause the vegetation to grow back slower.</td>
</tr>
</tbody>
</table>

The industry is changing very quickly in terms of PV technology types and associated costs. Constraining the project to a particular technology at this stage could be detrimental towards the viability of the project in the light of what will be realistic to construct in 2-3 years from now. Due to the fact that the impact on the environment of the two PV technologies is more or less the same, it is requested that the EIA allow for either one of these alternatives.

3.2.4 Mounting and film alternatives

PV solar power technology has been identified as the preferred technology to generate electricity in this project. There are, however, several alternatives in terms of the specific solar PV technology to be used. These alternatives can be grouped in terms of mounting and film alternatives but should not trigger any major difference in the impact of the project as explained in this report.
3.2.4.1 Mounting alternatives

There are two major alternatives in terms of solar PV mounting, namely fixed-tilt and tracker mounting technology. The following figure depicts the two mounting alternatives.

![Figure 11: PV mounting structures scenarios](image)

When fixed-tilt solar mounting technology is considered, the solar PV modules are fixed to the ground and do not contain any moving parts. These modules are fixed at a specific north facing angle. This type of technology is less expensive than tracker technology, but it has a lower energy yield due to the limited exposure to sun radiation.

The preferred technology type is known as horizontal tracker technology. This technology is designed to follow the path of the sun across the sky. By using this technology, the modules are exposed to typically 25% more radiation than fixed systems. The design is extremely robust and contains only a few moving parts. It also has more or less the same footprint and infrastructure requirements than that of fixed-tilt designs. The tracker requires approximately 1.8 to 2.3 hectares per megawatt. The tracking design is based on a simple design and makes use of a well proven off-the-shelf technology that is readily available. If conventional PV modules are used, the maximum height of the trackers is typically less than 2 m, but as previously stated, the CPV trackers are much higher, reaching a maximum height of approximately 10 m. The panels will most probably be mounted on either a single axis or a dual axis tracking system, both of which have a similar impact. However, because of unforeseeable changes in technology, it is requested that flexibility be granted in this regard in the EA.

The foundation of mountings can either be laid in a small concrete block, driven piers or a deep seated screw mounting system. The impact on agricultural resources and production of these alternatives are considered equal, although the concrete option will require greater inputs during decommissioning in order to remove the concrete from the soil. Driven piers and deep seated screws are recommended in order to minimise the environmental impact and input during decommissioning of the facility, but will be dependent on mechanical specifications.

If concrete foundations are used, foundation holes will be mechanically excavated to a depth of about 40 cm – 60 cm. The concrete foundation will be poured and be left for up to a week to cure.

Additional geotechnical investigation is expected to be done during the detail design phase which will assist in determining the feasibility of each technology option and influence the detailed design. The mounting structure choice will also be influenced by the technology advancement and pricing and should not be specifically indicated. It is requested that the EA allow for either one of these alternatives.
3.2.4.2 Film Alternatives

There are a multitude of different film technologies available within the market. The best solution, according to research conducted, are either thin film (amorphous silicon or cadmium telluride) or -crystalline cells (mono- or poly-crystalline) depending on the space and irradiance of local conditions.

As mentioned earlier, the film type do not affect the layout and impact from an environmental perspective and would not affect the environmental impact of the proposed project. Due to the industry changing very quickly in terms of costing of the different film types it is requested that the EA allow for either one of the alternatives.

3.2.5 The “do-nothing” alternative

This Remainder of the Farm 454, Dyason’s Klip, is currently used for limited stock grazing. The exclusion of 510 ha from the 5725 ha property for the purposes of the solar facility will not have a significant effect on these farming activities. Another solar development namely, RE Capital 3 (Pty) Ltd.; RE Capital 3B (Pty) Ltd and RE Capital 3C (Pty) Ltd. have been authorised on the same property. These projects were developed for the purpose of being submitted for the REIPPPP Round 4 project in August 2014. For more information pertaining to the location of RE Capital 3 sites, please refer to Figure 13.

The associated project impacts on the agricultural resources (soil and water) are expected to minimal. Should the do-nothing alternative be considered, the positive impacts associated with the solar facility (increased revenue for the farmer, local employment and generation of electricity from a renewable resource) will not be realised.

Cape EAPrac, the environmental assessment practitioners for this project will report on a full investigation on what environmental impact the option of not developing the proposed facility will have.

3.3 Access to facility

Access to the site will be along appropriate national, provincial and local roads. The access roads to the site will be from Upington or Keimoes, along the N14. The Dyason’s Klip farm entrance is directly accessible from the N14. There are different access routes investigated which could be used as access to the facility. The following figure depicts the different access route options and route alternatives.
The proposed site can be accessed either from the N14 on the south of the proposed site or from the provincial road on the north of the site. Access from the N14 can be either via the existing farm entrance on the north of the N14, or by means of the upgraded and existing Abengoa entrance from the N14. There are 5 access road alternatives, with three possible entrances, that are being investigated to determine which one will have the least environmental impact and would be more viable.

### 3.3.1 Entrance options
Three entrance options to the project site are investigated. Figure 12 depicts the various entrance routes and entrance options towards the proposed RE Capital 11 (Pty) Ltd. site.

The first entrance (1) being directly from the N14 from the existing entrance of the Remainder of Farm 454, Dyason’s Klip. The second possible entrance (2) being the existing Abengoa entrance and access road from the N14. The third possible (3) entrance being the entrance to Dyason’s Klip farm from the district road (D3276) on the North of the Dyason’s Klip farm.

Solek had previous engagements with “South African National Road Agency” (SANRAL) regarding entrance from the N14 for RE Capital 3 developments on the Remainder of Farm 454, Dyason’s Klip. SANRAL agreed that the existing farm entrance or the existing Abengoa entrance may be used.

### 3.3.2 Previous completed EIA layouts
Three similar Solar PV sites have been developed on the Remainder of Farm 454, Dyason’s Klip. These developments are awaiting its final “Record of Decision” (ROD) from the Department of Environmental Affairs. For the purpose of referring to RE Capital 3 solar projects the figure below illustrates the location of RE Capital 3 solar projects. During the planning of RE Capital 11 site location, its corresponding access roads and power lines for grid connection the RE Capital 3 projects have been taken into consideration.
Five different route alternatives are included within the considered access routes of this scoping report. Each of these five access routes utilises one of the discussed entrance options. Figure 12 depicts the alternative routes towards the project site.

### Route alternative 1 and 2
Access road alternatives 1 and 2 utilise the same planned and assessed access roads than that of the Round 4 REIPPP proposed projects (formerly known as RE Capital 3 (Pty) Ltd project). The RE Capital 3 (Pty) Ltd. access road was planned to follow the existing farm road as far as possible in order to minimize the environmental impact.

From the point where the Round 4 project assessed access roads end (Southern border of RE Capital 3 (Pty) Ltd project site), the two alternative access roads is directed either to the eastern boundary of RE Capital 3 or the western boundary of RE Capital 3.

Route alternative 1 pass RE Capital 3 development towards the western boundary of RE Capital 3 and pass through the 50 meter separation corridor of RE Capital 3B and RE Capital 3C solar farm development.

Route alternative 2 pass RE Capital 3 development towards the eastern boundary of RE Capital 3 and pass through the 50 meter separation distance between the RE Capital 3 eastern border and the farm border.

### Route alternatives 3 and 4
Access road alternatives 3 and 4 is planned to utilise the existing Abengoa entrance and access road on the neighbouring farm (eastern side of Dyason’s Klip) which was constructed for the Abengoa Khi...
Solar One project. This neighbouring access road runs through Rooi Punt, Tungsten Lodge entering through the McTaggarts Camp entrance from the N14 at Point 2 depicted within Figure 12.

Access road alternative 3 and access road alternative 4 differs from each other in the way by which they cross over to the Dyason’s Klip farm property.

Alternative 3 utilises the Abengoa road upto the southern border of the Abengoa development from where the proposed Alternative 3 route traverse to the west across Rooipunt and onto the Dyason’s Klip property from where it joins Route alternative 2 (between the Eastern border of RE Capital 3 development and the farm boundary).

Alternative 4 utilises the same access route and existing Abengoa road as Alternative 3, but extends this usage further north to the North-western corner of the existing Abengoa development. The proposed alternative 4 crosses the Abengoa border, the Rooipunt farm onto Dyason’s Klip in this area due to the fact that less environmental impact is expected on crossing of washers.

There is a possibility however that the existing Abengoa access route and traversing of their land could not be used due to servitude negotiations and the financiers of the REIPPPP projects requirement that projects are ring-fenced. This option is however added to the scoping report due to the possibility of utilising this option.

3.3.3.3 Route alternative 5
The 5th alternative access road enters the Dyason’s Klip Farm on the Northern boundary and intersection with the district road D3276. The proposed route runs South towards the project site, with the specific proposed route being influenced by expected sensitive areas and potential future developments.

3.4 Water related items
The following portion of the report are dedicated to discussions pertaining to water, the volumes and seasonality of the project requirements, the sources available, the infrastructure pertaining to water usage, the legislative approvals required for water usage and the corresponding environmental impact risks thereof.

3.4.1 Water requirements
The project requires about 8 litres of water per panel per annum for the purposes of construction and maintenance (cleaning of the panels). The capacity of the panels that will be used will therefore determine how many water will be required for a 75 MW plant. If a 250 Watt panel is used, a 75 MW plant will consist of more or less 300 000 panels, which will roughly calculate to 6.6-8 kl of water required per day (2'400-2'900 m³/annum). The 10 kl capacity tanks will be places on site in order to store 100 000 litres of water at any given time, effectively providing a storage capacity of two to three days of cleaning water supply. The water distribution system will distribute water from the ten 10 kl water tanks to a high pressure hose and on to the solar panels. The proposed activity is not a “water intensive activity” (as opposed to CSP technology). Only a limited amount of water is required in low rainfall periods to clean the modules once every quarter so that they can operate at maximum capacity. No chemicals will be used to clean the panels, only water.
Weather conditions, traffic and general dustiness at the site play a role in the exact amount of water required to clean the solar PV panels. At present it is assumed that each panel should be washed once every three months.

To further reduce the use of water at the solar facility, the use of alternative panel cleaning methods is also being investigated. The most feasible technology under consideration uses compressed air to blow off any debris from the panel’s surface. At this stage the technology is being tested and needs refinement before it would be commercially viable. Other cleaning options are currently under development where rotating rubber-based waterless cleaning is used. Cleaning technologies are improving overtime and it is expected that more innovative cleaning technology will be developed, further reducing or eliminating water requirements although these are not fully commercially proven.

The development is expected to apply for a water use licence, from the Department of Water Affairs, as part of the development process. A water use licence is expected to be required for any water extraction (boreholes, rivers or channels) or for crossing river beds/washers. The requirements to apply for a water use licence are expected to be confirmed and directed by the appropriate specialists.

3.4.2 Water sources
There are a number of different water sources which can be further investigated to supply water for the project. The following section investigation these options.

1. Boreholes:
The preferred water sources are the existing boreholes on the proposed farm. Four boreholes have been identified on the farm of which two boreholes are situated near the proposed site. These boreholes are seen as a possible water option for the facility. The small volumes of water required for washing the solar PV modules and for general operational purposes (maximum expected usage of 3'000 m$^3$/annum) are expected to be sourced from these boreholes. According to the farmer the boreholes are strong enough and the water they supply is drinking water quality.

Depending on where on the final design the water tanks will be located, the water from the boreholes will probably be pumped to the water tanks through a pipeline. The pipe diameter will be approximately 50mm – 150mm. The pipeline will be laid on the ground, or just below the ground by means of manual excavation. The water pipeline should not result in any additional environmental impacts outside of the main construction area.

Borehole pump tests and corresponding confirmation of water availability is expected to be conducted after preferred bidder status.

2. River water
An additional option is the consumption of river water. The Orange River, a perennial river, is nearby and the consumption of water from the river is a potential water source. Obtaining water from the Orange river for non-agricultural purposes will have to be approved by the Department of Water Affairs. Should such an approval be obtained, it could be considered to construct a pipeline to service the project or to draw water on the Dyason’s Klip property which extends up to the Orange River.
3. **Khai Garib municipality (alternative supply)**

Permission to use water directly from the two nearest towns, Upington and Keimoes, can be sought from the Khai Garib Municipality. This water will also have to be transported by trucks to the proposed site. This will be seen as the last alternative as transport costs will be significantly higher compared to the other two options. The usage of municipal water can reduce the requirement of obtaining a water use licence from the Department of Water Affairs in terms of the extraction of water from resources such as groundwater or rivers.

4. **Rainwater**

As an additional measure, PVC rainwater tanks could also be placed alongside the on-site buildings to collect the rainwater runoff from the roof. These PVC tanks will then form part of the water storage tanks.

3.4.3 **Water buffer**

Water storing infrastructure is to be provided as part of the auxiliary building footprint area. Storing capacity for two weeks are planned to be provided for. This will add up to ten 10 kl water tanks.

![Figure 14: Typical water storage tank](image)

3.4.4 **Water-use permission**

The quantity of water required usually qualifies for a general authorisation, but the specific quaternary area in which the development site is situated does not allow for general authorisation. Thus, a formal water use licence would have to be applied for. However, as also stipulated in the official REIPPPP documentation (RFP, Volume 1, Part 1, Section 4.5) the DWA will only process water use licence applications from developers who have been selected as Preferred Bidders. Therefore a full assessment of the water-use licence application will only be undertaken by the Department of Water Affairs (DWA) once the project is approved. The EIA application can therefore be submitted without a water licence, as long as there is enough confirmation that there are sufficient water available. A Non-binding Water Confirmation Letter for the project have been applied for at the DWA, in which the DWA is asked to confirm that according to their information there should be adequate water available for the project. The DWA are also registered as a key stakeholder in the environmental process and will have an opportunity to provide any additional input.

3.4.5 **Erosion and storm water control**

In addition to the below mentioned and as part of storm water control, a third party specialist has been appointed to compile a Storm Water Management Plan that will be compiled and included in the draft environmental impact report.
The risk of water erosion is low because of the extremely low annual rainfall in the area. The ground condition in the Upington area is such that any surface water is very quickly absorbed into the soil. This avoids water build up on the surface and quickly reduces any water flow which might cause water erosion.

On large structures or buildings appropriate guttering could be used around the building to avoid water erosion where roof water would be flowing off the roof. Wherever practically possible rainfall run-off from the roofs/gutters will be captured and stored in rainwater tanks. If this water cannot be captured, water will be channelled into energy dissipating structures to spread the water and slow it down to reduce the risk of erosion. Such a structure could be moulded from precast concrete, loosely packed rock or perforated bags filled with stone.

Any rainfall on the solar modules would be welcomed due to its cleaning effect, but as mentioned before the annual predicted rainfall is very low and would not cause any erosion worth discussing. The solar module surfaces are installed at a relatively large incline with gaps between modules. This does not allow significant water build up on the modules while also reducing the energy in falling droplets. Should a tracking technology be used this implies that droplets leaving the solar module surface would not drop onto the same ground areas all the time.

The construction area might cross over a number of seasonal washes. To avoid erosion in these washes recognised building practices will be followed to keep the natural flow of water within its natural borders. It is in the interest of the solar operator to keep the area clean and free of erosion to avoid any damage to the equipment. The solar modules would be installed on frames, allowing for natural water flow underneath the structure.

During the construction phase of the project there might be a risk of wind erosion where natural vegetation is removed. This might increase the risk of damaging sensitive equipment with a sandblasting effect and all parties involved will be vigilant to avoiding this from happening. Note that the construction will take place in three phases. This phased construction approach should also minimise the amount of exposed soil at any one time thus reducing the risk for wind erosion and dust generation. Once the construction on each phase is complete the cleared areas is expected to be re-vegetated with locally-collected seed of indigenous species and left for vegetation to return to the area naturally. Bare areas is envisioned to be packed with brush removed from other parts of the site to encourage natural vegetation regeneration and limit erosion. Any water being used in the cleaning process would speed up this natural vegetation rehabilitation process. Further it will also have a bonding effect on the sandy soil, avoiding the loose sand blowing away causing wind erosion.
Access roads and internal roads would also be designed and built using recognised erosion and storm water management systems. During the construction phase of the solar PV facility temporary solutions would be implemented to ensure that the environment is preserved in a sustainable way by avoiding erosion. The following figure shows a typical temporary solution that would be implemented during the construction phase, basically consisting of an inlet, channel and outlet. During outflow of the water energy is dissipated allowing any particles to sink to the ground which also avoids fast flowing water to sweep particles up from the ground avoiding erosion, by flowing though packed stones acting as a filter.

More permanent solutions would be designed to keep storm water under control in a sustainable way. These structures would be built to be aesthetically pleasing by using fixtures such as stones packed in wire mesh to stay in a position or locking retaining walls at the inflow and outflow of the culverts also acting as scour protection. Depending on the situation which is influenced by the type of water control most probably being stream crossing (in this particular case it would be a dry water
wash for most of the year) or a culvert for water runoff management, either portal culverts with bases or reinforced precast concrete pipes would be used as the channelling.

![Diagram of storm water flow](image)

**Figure 18: Storm water flow**

An alternative to culverts considering drainage line crossings, Low-level River Crossings (LLRC) can be used. A LLRC is a structure that is designed in such a way to provide a bridge when water flow is low, while under high flow conditions water runs over the roadway, without causing damage.

Two types of LLRC can be used depending on the particular situation. A “Causeway” contains openings underneath the surface, which allows passing water through where a “Drift” does not.

![Diagram of causeway](image)

**Figure 19: Causeway (Low Level River Crossing)**

The same type of erosion control methods discussed with the culverts is taken into account when designing a LLRC. Because a LLRC is designed for water to flow over it, erosion protection is very important. Rock filled baskets, loosely packed rock or perforated bags filled with stone are some of the methods usually considered with LLRC.
The water use licence application process will include application for potential crossings of water courses in terms of Section 21(i)&(c) of the national water act. This application process will only commence if the project is selected as a preferred bidder.

3.5 Grid connection
In the Scoping Phase six power line route alternatives were investigated, including the loop-in loop – out route option. Because of possible complications with neighbouring projects, it was decided to include alternative option 3 to the South boundary of Tungsten Lodge.

3.5.1 Grid Connection and Power Line Routes
In this Scoping Phase six power line route alternatives were investigated, including the loop-in loop – out route option. Because of possible complications with neighbouring projects, it was decided to include alternative option 3 to the South boundary of Tungsten Lodge.

3.5.2 Loop in Loop out Alternative
The option to loop into the existing 132 kV line is investigated as one of the primary connection alternatives. This option is indicated as “REC 11 PV Line Loop in Loop out 01” in Figure 20 below. The other alternative routes will all lead from the individual on-site substations to the authorised Eskom Upington MTS. The ESKOM MTS substation EIR was authorised on the 14th of February 2014 by the Department of Environmental Affairs.

3.5.3 Self-build Alternative 1
The power line alternative options 1 as illustrated in Figure 20, runs along the eastern Dyason’s Klip boundary crossing the neighbouring Rooipunt portion and the Tungsten Lodge property at the northern boundary of Tungsten Lodge farm, but on the Tungsten Lodge property. After crossing the Tungsten Lodge farm, the line runs south along the western boundary of Eskom property towards the new authorised Eskom Upington MTS substation.

3.5.4 Self-build Alternative 2
The power line alternative options 2 as illustrated in the figure below runs along the eastern Dyason’s Klip boundary up to the existing 132kV power line crossing the neighbouring Rooipunt portion and runs parallel the existing 132kV power line towards the authorised Eskom Upington MTS substation location.

3.5.5 Self-build Alternative 3
The power line alternative options 3 as illustrated in the figure below follows the same route as alternative 2 and the crosses neighbouring Rooipunt portion and the Tungsten Lodge property at the southern boundary of Tungsten Lodge farm towards the authorised Eskom Upington MTS substation location.

3.5.6 Self-build Alternative 4
The power line alternative options 4 as illustrated in the figure below follows the same route as alternative 1, but crossing the neighbouring Rooipunt portion and the McTaggarts Camp property at the southern boundary of McTaggarts Camp. The line is located on the property of Mc Taggarts camp when traversing the property. After crossing the Mc Taggarts Camp property the line runs south towards the new authorised Eskom Upington MTS substation location.
3.5.7 Self-build Alternative 5
The power line alternative options 5, as illustrated in the figure below, crossing Rooipunt farm southern boundary, the line is located on the Rooipunt farm itself, where after the line runs south along the western boundary of Eskom property towards the new authorised Eskom Upington MTS substation.

3.5.8 Grid connection discussion
The loop-in option will be most cost effective, but this is dependent on the capacity on the line. Options 1 and 2 are the next two preferred options, being the shortest distance to the substation and parallel to the existing 132 kV line. However, the feasibility of most of these options will depend on the neighbouring project’s servitude consent. That is also the reason for the large number of alternative options. Negotiations are in progress for all the servitudes. The routes were all chosen along existing fences or power lines, in order to minimise the additional environmental impact. The environmental impact of these alternatives should all be more or less the same.

![Figure 20: Six Power Line Alternatives for the Proposed Site](image)

The summarised grid connection alternatives and their distances from the onsite substation to the new authorised Eskom Upington MTS substation or existing 132kV line is illustrated in Error! Reference source not found.

Table 3: Grid connection alternative distances

<table>
<thead>
<tr>
<th>Alternative grid connection</th>
<th>Distance (km)</th>
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<tbody>
<tr>
<td>REC 11 PV PLine Loop in Loop out 01</td>
<td>5.1</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 01</td>
<td>9.5</td>
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<tr>
<td>REC 11 PV PLine Selfbuild 02</td>
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<td>11.7</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 04</td>
<td>9</td>
</tr>
</tbody>
</table>
3.6 Services Required

Due to the remote location of the proposed site, making use of municipal services is very difficult. It is therefore proposed to manage the Water and Electricity, Sewage and Waste Removal aspects independently.

3.6.1 Water

Water will be sourced from either the two boreholes close to the site, the Kai Garib municipality or other third party suppliers. Permission has been obtained from the farmer in the lease agreement, that the borehole water may be used. According to the farmer the water is drinking water quality. The water will be stored on site in standard 10kl water tanks. Due to the small amount of water needed, water can also be obtained for the Kai Garib municipality and transported to the site by standard water trucks, should the borehole water not be sufficient.

3.6.2 Electricity

Electricity will be needed during the construction period as well as the operation period in the support offices, security systems etc. The proposed site is approximately 7km away from the nearest Eskom point on the southern part of the Dyason’s Klip farm. It is proposed to either use generators for electricity, or alternatively make use of a number of PV panels during the construction period. As part of the infrastructure installed, it is proposed to utilise on-site electricity reticulation from the on-site substation towards the required areas by utilising the accounted infrastructure. As an additional option it is proposed to make provision for the utilisation of an off-grid, on-site solar system for the required on-site electricity. Approvals of the different options in supplying on-site electricity are requested in order to allow for cost effective solutions for this project.

3.6.3 Waste effluent, emission and noise management

3.6.3.1 Solid waste management

During the construction phase an estimated amount of less than 5 m³ non-hazardous solid construction waste are to be produced per month, for the expected 12-18 month construction period. An independent service provider will be used to safely store all construction waste, and remove it from the site on a scheduled (weekly or bi-weekly) waste removal basis. The construction waste, where applicable, are to be disposed at a municipal landfill site that is appropriately licenced. As far as possible the waste hierarchy should be applied in order to reduce, re-use and recycle waste. The Environmental Management Programme will address solid waste management during construction.

During the operational phase after construction, the facility is not expected to produce any solid wastes.

3.6.3.2 Liquid effluent (sewage)

The liquid effluent generated is expected to be minimal and limited to the ablution facilities. All workers will be transported to site on a daily basis should the workers not be housed on site. Should the workers be housed on site, sufficient temporary chemical ablution facilities will be on site during the construction phase. These chemical toilets will be serviced and emptied on a weekly basis by a
The sewage will be transported to a nearby Waste Water Treatment Works for treatment.

The on-site permanent sewage solution for the operation period of the facility is expected to either utilise a combination of a septic tank or french drain or a conservancy tank, as determined by the local authority. Due to the locality of the farm, sewage cannot be disposed in a municipal sewage system.

3.6.3.3 Emissions into the atmosphere and noise generation

Very little emissions should be released into the atmosphere and no significant noise should be generated, except during the construction period with drilling and hammering. Due to the site location this should not pose any issue as no residential area is located nearby.

4 Construction of the proposed facility

The proposed facility will be for 75MW. The planned construction is estimated to be between 14-18 months. During the construction activities an estimated 5 jobs will be created for each MW of installed capacity. Therefore an estimated job creation of 375-450 employees are expected during the construction of the 75-90 MWp facility, of which most will ideally be local employments. The construction material and sourcing of required goods can be from the local community and surrounding towns.

Should the project be approved, and all required approvals and licences are obtained from the DEA, NERSA and a Power Purchase agreement (PPA) is secured with Eskom, the construction is envisioned to begin in the second half of 2016. A series of activities would need to be undertaken, to construct the proposed facility and associated infrastructure.

Each facility will be established in different phases, once financial close was reached, namely: the pre-construction, construction, operation and decommissioning phases.

The preconstruction phase includes:

1. Conducting of surveys
2. Appointment of contractors and sub-contractors
3. Transporting of the required construction components and equipment to site
4. Pre-site preparation (establishment of temporary services for construction such as lavatories, water, health and safety requirements, site office, etc.)

The construction phase includes:

1. Transportation of solar components and equipment to site
2. Establishment of internal access roads
3. Undertaking site preparation (including clearance of vegetation; stripping of topsoil where necessary)
4. Erecting of solar PV frames and panels
5. Cabling (DC) low and medium voltage (LV/MV)
6. Installing of inverter rooms
7. Establishing the underground connections between PV panels and inverters
8. Constructing the on-site substation
9. Establish connections between inverters and on-site substation
10. Establishment of additional infrastructure (workshop and maintenance buildings)
11. Connection of on-site substation to power grid
12. Undertaking site remediation
13. Construction of perimeter fencing

The activities that will be undertaken on site fall under different specialist fields and include:

- **Civil works**: site preparation, site grading, drainage, roads, foundations, storm water & anti-erosion management and site remediation.

- **Mechanical works**: piers/sub-structure installations, mechanical assembly including trackers; mounting of panels; substation delivery, and lastly the installation of perimeter fencing.

- **Electrical works**: installation from low to high voltage, including substation connections.

For the purpose of the engineering report, the stages of the construction phase that have engineering implications will be discussed.

### 4.1 Traffic management and transportation

In addition to the below mentioned and as part of the transportation of equipment and personnel, a third party specialist has been appointed to compile a Transportation and Traffic Management Plan that will be compiled and included in the draft environmental impact report.

All solar plant components and equipment are to be transported to the planned site by road. Construction is expected to stretch over a period of approximately 18 months. During this period the majority of the solar PV panels and construction components will be transported by utilising container trucks (e.g. 2 x 40 ft container trucks or a similar option).

Less than 30 containers will be required per installed MW. This will typically include all solar PV components and additional construction equipment. Over the period of 18 months, 2250-2700 containers will therefore be transported to the proposed site. Roughly estimated this amounts to approximately three 2 x 40 ft container trucks per day.

Normal construction traffic will also need to be taken into account. The usual civil engineering construction equipment will need to be transported to the site (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.). The components required for the establishment of the on-site substation power line will also need to be transported to the site. Some of this power station equipment may be defined as abnormal loads in terms of the Road Traffic Act (Act No.29 of 1989). Input and approval are to be sought from the relevant road authorities for this purpose.

Transport to the site will be along appropriate national, provincial and local roads. The access roads to the site will be from Upington or Keimoes, along the N14. This is a tarred national road and no alterations should be necessary to handle construction traffic and traffic involved in the operation phase.

In some instances, the smaller farm roads may require some alterations (e.g. widening of corners etc.), due to the dimensional requirements of the loads to be transported during the construction
phase (i.e. transformers of the on-site substation). Permission from the local authorities can be obtained in this regard.

The exact access routes that are considered are discussed in more detail within the layout report.

### 4.2 Establishment of internal access roads on the farm

Minor internal maintenance roads on the farm and proposed construction site are to be constructed. Where necessary, gravel may be used to service sections of the existing road on the farm itself. In order to form an access track surface some of the existing vegetation and level the exposed ground surface might need to be stripped off. The impact of this will be assessed by the botanical specialist. These access tracks (typically 6 m wide or less) will form part of the development footprint. In order to allow enough space for the larger vehicles to turn easily a width of 6m will be proposed. The layout and alignment of these internal roads will be planned and influenced by the recommendations made by the botanical specialist, as well as the topographical survey. Pathways (typically less than 6 m wide) between the solar PV modules are to be provided for ease of maintenance and cleaning of the panels.

In addition, a fire break (buffer area) that can also serve as an internal road will be constructed around the perimeter edges of the entire proposed site. All gravel access roads constructed will be more or less 6 m wide.

### 4.3 Site preparation

Cleaning of the surface areas is necessary in order to construct the solar PV plant. This will include clearance of vegetation at the footprint of the solar PV modules, the digging of the on-site substation and workshop area foundations and the establishment of the internal access roads and lay-down areas. Where stripping of the topsoil is required, the soil is planned to either be stockpiled, backfilled and/or spread on site. In the instance where there are cultivated areas currently on the site, the upper 30 cm of the cultivated areas is planned to be stockpiled on the boundaries of the site. The topsoil stockpiles must be protected from erosion by re-establishing vegetation (grasses) on them. The environmental management plan will provide specifications for this vegetation re-establishment.

![Figure 21: Illustration of a typical site after preparation](image_url)

To reduce the risk of open ground erosion, the site preparation will typically be undertaken in a systematic manner. Where any floral species of concern or sites of cultural/heritage value are involved, measures are to be put in place to attend to the preservation or restoration of these elements as recommended by the botanical specialist.
4.4 Erecting of solar PV modules

Once the site preparation has been done, and all necessary equipment has been transported to the site, the solar PV modules and structures are assembled on site. Each solar PV module consists of a number of cells, forming a single panel. Each module is capable of generating typically 200 W - 300 W of DC electrical power. If conventional Solar PV technology is used, the solar PV modules are assembled in blocks of rows, forming a network of strings, across the solar PV array. There is a separation distance between the rows of approximately 5 m. The exact amount of modules in each solar PV array is subject to the final facility design and will be finalised as part of the detailed design phase. If CPV technology is to be used, the distance between the modules are carefully calculated to ensure the trackers have enough room to rotate and the shadows are taken into account. Foundation holes for the solar PV modules are to be mechanically quarried to a depth of approximately 400 - 800 mm. Driven piers and screws are recommended in order to minimise the environmental impact of the facility, but will be dependent on mechanical specifications.

If concrete foundations are used, foundation holes will be mechanically excavated to a depth of about 400 - 600 mm. The concrete foundation will be poured and be left for up to a week to cure.

4.5 Construct on-site substation

An on-site substation will be necessary to enable the connection between the solar energy plant and the National Eskom electricity grid. The generated voltage is planned to be stepped up to 132 kV by means of an on-site substation in order to be fed to the Eskom grid via a planned connection to the new authorised Upington MTS Eskom substation. The on-site substation and its associated infrastructure and internal roads should have a footprint of approximately 0.04 ha (20mx20m).

The on-site substation is constructed in a few sequential steps. First a site is determined by the recommendations from the reports of the environmental specialists to avoid the most sensitive areas in the positioning of the substation (a geological study is expected to be conducted prior to the finalisation of the on-site substation and is expected to be taken into account for this purpose).

Once the site is approved, the site clearing and levelling is to be done, after which the access roads to the substation are constructed. Next the substation foundation is laid. Once the foundation is constructed, the assembly, erection and installation of all equipment, including the transformers, are to be completed. The final step is the connection of the conductors to the equipment.

The post-construction phase includes the rehabilitation of disturbed areas and protection of erosion sensitive areas. Below is typical on-site substation that connects to the existing Eskom substation.
4.6 Establishment of additional infrastructure

To minimise the potential ecological impact a project of this scope could have, a decision was made to limit all activities and storage of equipment to one nominated area. A dedicated construction equipment camp and lay-down area are planned to be established (further referred to as the “laydown area”), which will then form part of the auxiliary building area.

The laydown area for the construction period will be approximately 2ha. This area will typically be used for the assembly of the solar PV modules and the generation placement/storage of construction equipment. A temporary facility are planned to be used to secure the storage of fuel for the on-site construction vehicles. Necessary control measures will be put in place for correct transfer and use of fuel.

The auxiliary building area will typically consist of a workshop area; storeroom area; change and ablution room area; administrative and security building; 10 x 10'000 L water tanks.

4.7 Connect on-site substation to power grid

In order to evacuate the power generated by the proposed facility and feed it into the Eskom grid, a distribution line would have to be constructed between the proposed on-site substation and the grid connection point, either the new authorised Eskom MTS substation or to an existing 132kV line (loop-in(loop-out)).

According to the official ESKOM TDP 2013-2022 document, Eskom plans to build a 5 x 500 MVA 400/132 kV transmission substation 5-10 km from the proposed Dyason’s Klip Farm and corresponding project site. The new authorised MTS substation will be a key substation in the Upington and Northern Cape area.

One of the main purposes of the new authorised Upington MTS substation is to enable exporting of the generated renewable energy from the local distribution network onto the national transmission network. The MTS was planned and designed in such a way to accommodate the proposed renewable projects in the area. With a planned 5 x 500 MVA 400/132 kV transformer capacity available in the Upington MTS, the proposed project as well as the surrounding projects in the area will find that there is ample capacity at the new authorised Upington MTS substation in order to export the generated energy onto the transmission grid.
A grid feasibility application will be submitted to Eskom, in order to confirm the connection possibilities of this project.

The following figure depicts the different alternatives of connecting to the existing Eskom grid. Two of the options which will be investigated for grid connection are either the first of a “loop-in/loop-out” into one of the existing 132 kV lines (currently running over the farm or across the neighbouring farm) and the second option is to build a new line directly to the new authorised MTS Eskom substation. The “loop-in/loop-out” option will be subject to the available capacity on the existing 132 kV line, which shall be further investigated and discussed with ESKOM as part of the cost estimate letter request.

![Figure 24: The different connection alternatives](image-url)

Should it not be possible to utilise any of the “loop-in/loop-out” options, a new line (or two lines, depending on the line capacity) will be built to the new authorised Eskom Upington MTS substation. This line(s) will be constructed by the developers, but would be handed over to Eskom for operation and maintenance. Application for the new line(s) is noted within this Environmental Process and also depicted, although a separate “Basic Assessment” (BA) will be performed for the grid connection options.

As part of the environmental impact assessment and the engagement with Eskom pertaining to a grid connection application, feedback from Eskom is expected to provide guidance towards the
planned expansions, possible loop-in/loop-out options and the potential scenarios within the final Cost Estimate letter. Eskom's recommendations will be taken into account and used within the environmental impact assessment phase as far as possible.

4.8 Undertake site remediation
Once construction is completed and once all construction equipment is removed, the site is to be rehabilitated where practical and reasonable. In the case where access routes to the site will not be used during operation, the access points are to be closed and rehabilitated as detailed in the future Environmental Management Programme.

5 Project operation and maintenance phase
The proposed operation of the site is for 25 years. During this life-cycle, the plant will be maintained and monitored. The aim is to generate at full capacity by the second half of 2017. The facility should be operational (generating electricity) during daylight hours, except during maintenance, poor weather conditions or breakdowns. Regular maintenance will typically include periodic cleaning, greasing of bearings and inspection. The modules are planned to be cleaned with water or compressed air. Any waste products are to be disposed of in accordance with the National Environmental Management: Waste Act (Act 59 of 2008).

During the operations approximately 1 job will be created for each MW of energy. The staff members will typically include technicians, maintenance and security personnel. Staff can be transported around the site using utility vehicles and a typical mini bus to transport staff from nearby towns of Upington, Keimoes and surrounding community. From time to time additional contract staff may be required for ad hoc ground cleaning or special panel cleaning.

When the solar modules and associated equipment become defective, they will be recycled and reused where possible in order to avoid the further congestion of already limited landfill space.

6 Project decommission phase
The proposed solar energy facility is expected to have a lifespan of approximately 25 years if the specified periodic maintenance is performed. If financially viable and depending on climate factors in 25 years’ time (farming may no longer be viable) the PV facility may continue operating. Existing infrastructure and components of the PV facility may be replaced with new technology.

Once the facility has reached the end of its economic life, the infrastructure is to be decommissioned. The decommissioning of the facility would entail the disassembly and replacement of components with other appropriate technologies. However, if not deemed so, then the facility would be completely decommissioned.

Preparation activities for site decommissioning should include confirming the integrity of access to the site. Site access should be able to accommodate the required equipment (e.g. lay down areas, construction platform) and the mobilisation of decommissioning equipment. The components would be disassembled, reused and recycled where possible, or disposed of in accordance with regulatory requirements. Functional components are planned to be donated to and installed at local schools and clinics to benefit the community as far as possible.
7 Cost implications & revenue

7.1 Project cost overview
Renewable energy projects, such as the proposed solar facility, require significant capital investment. Funds of equity and debt investors either from foreign or domestic sources are obtained. The cost requirements and potential revenue are discussed in this section, sketching a business case for the development of renewable energy projects within South Africa (specifically solar farms in the Northern Cape).

The project costs consist of two parts, capital cost and running cost. The capital cost pertains to all costs incurred for the establishment of a producing facility. The running cost relates to those costs incurred to ensure that the facility operates as it should throughout its expected lifetime.

Solar PV installations can operate for many years with little maintenance or intervention. Therefore after the initial capital outlay required for building the solar power plant, further financial investment is limited. Operating costs are also limited compared to other power generation technologies.

7.2 Project specific costs
The Re Capital 11 detail costing has not been completed on the date of submitting this engineering report. The project is, however, based on the industry standard cost with capital expenditure that can amount to more or less R20-25M per megawatt installed capacity. The running cost of a solar PV facility is minimal related to the initial capital cost, contributing to the most significant cost of constructing and running a solar PV facility.

7.3 Revenue streams
The payback of the facility results mainly from electricity sales, intended under the current governmental subsidy, known as the “Renewable Energy Independent Power Producer Procurement Programme” (REIPP Procurement Programme).

The IPP procurement programme portrays fixed ceiling prices for bidders to tender against. The establishment of these ceiling prices is based on industry standard return on investments. The governmental study performed identified the feed-in tariff per technology related to the capital cost required per technology against its revenue potential, identifying the required subsidy per technology to be paid in order to create a lucrative investment and attract investors.

In short the subsidy offered by the governmental procurement programme (IPP procurement programme) enables the project to be financially viable by selling electricity at a subsidised price, while the costs of such a facility relates to the industry standard.

As part of the IPP procurement programme preferred bidders will enter into a power purchase agreement between the IPP generator and the Single Buyers Office/Department of Energy. National treasury provides surety, while NERSA regulates the IPP licences.

The bidding and tender procedure of the IPP procurement programme requires an approved EIA Environmental Authorisation/Record of Decision as a gate keeping criteria, where no project would be considered without the EIA Environmental Authorisation being given.
8 Project programme and timelines

As mentioned previously the Re Capital 11 solar development is intended to be lodged under the IPP procurement programme. The programme has definite and stringent timelines, which the project should meet:

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Timeline</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Expected IPPPP submission date (5th round)</td>
<td>Aug 2015</td>
</tr>
<tr>
<td>2</td>
<td>Preferred bidders selected</td>
<td>October 2015</td>
</tr>
<tr>
<td>4</td>
<td>Procurement of infrastructure</td>
<td>August 2016 – September 2016</td>
</tr>
<tr>
<td>5</td>
<td>Construction</td>
<td>October 2016 – March 2017</td>
</tr>
<tr>
<td>6</td>
<td>Commissioning</td>
<td>March 2017 – July 2017</td>
</tr>
</tbody>
</table>

The table above clearly depicts the dependence of the project on the IPP procurement programme’s timelines. Any delay within the IPP procurement programme will have a corresponding effect on the timelines of the projects timelines.

Although no official public submission date for Round 5 have been communicated by the Department of Energy, there have been reports of an accelerated Round 5 timelines, with the submission date potentially brought forward to May/June 2015. The impact of such an accelerated timeline could have a significant impact on RE Capital 11 due to the already limited additional time within the EIA process in order to obtain a “Record of Decision” prior to submission date.

9 Conclusion

In conclusion, the overall significance of the proposed Re Capital 11 solar development outweighs the negative impact the project can have. From an environmental perspective the project can be well-managed with sound contingencies being put in place to prevent harm to surrounding areas.

The project does make significant contribution from a social and economic perspective. Such benefits include potential revenue for the landowner, job creation during construction and the 20-30 year operational phase. In addition, much needed electricity is generated and fed into the ESKOM national grid, taken from a natural energy resource that is sustainable and carbon-free.

Recommended mitigation measures will be developed and contained within the environmental management plan (EMP). Should these mitigation measures be implemented, there should be no lasting significant negative environmental impact arising from the development of the project. This pertains to the construction phase as well as the operational phase. Solar projects use remarkable technology which can ensure a sustainable future for electricity generation. This is especially true since it does not severely impact the environment as with coal power generation or similar technologies.

In the light of the long term benefits the solar development has, upon approval of this application the project can be implemented with minimum environmental negatives.