RE Capital 11 (Pty) Ltd. Solar farm development.

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Abbreviations and Acronyms

- AC  Alternating Current
- BA  Basic Assessment
- CPV  Concentrated Photovoltaic
- CSP  Concentrated Solar Power
- DC  Direct Current
- 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
- IPPPPP  Independent Power Producer Procurement Programme
- PPA  Power Purchase Agreement
- LV  Low Voltage
- MV  Medium Voltage
- MW  Mega Watt (Power)
- MW<sub>p</sub>  Mega Watt Peak (Maximum peak power production)
- 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 an electrical planned peak production 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 its 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 construction, operation, maintenance and the possible effects thereof 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, the significance of the renewable energy sector in this context and the opportunity for solar energy in the Northern Cape. The overall project and proposed facility is described in more detail by investigating the following key points:

- 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 renewable energy market in South Africa has gained considerable momentum since the inception of the governmental subsidy program known as “South African Renewable Energy Independent Power Producers Procurement Program” (REIPPP). 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.

The third round of the projects have been awarded and construction of Solar energy projects (“Photovoltaic”(PV); “Concentrated Photovoltaic” (CPV) and “Concentrated Solar Power” (CSP)) and Wind Energy projects are in progress. The fourth round submission of bids and tender submissions are in mid-August 2014 and expected to be announced by November 2014.
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 REIPPPP 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.

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.

![Figure 1: South African solar irradiation distribution](image)
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.

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.). 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). The remainder of the study area is expected to be submitted at a later stage in a separate EIA application for an additional solar farm development.

The proposed project area is located approximately 8 - 10 km from the planned new Eskom MTS Substation, on the authorised location based on the Remainder of Farm 644, Olywenhoutsdrift. The EIA for the new MTS are 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 increased/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 depicts an overview of a typical solar PV facility and some its main infrastructure components.

![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 path of the sun 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 production increase to full power and stays on maximum production for a longer time 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 MW 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 and the corresponding reliance on fossil fuel. 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 contribute to the overall achieving of 40% share of new power generation being produced by IPPs nationally (as outlined within the “Integrated Resource Plan”, IRP 2010).

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 of between 200 and 240ha. The initial study area of 510ha is included within for the environmental specialists area. The remainder of the study area is expected to be submitted at a later stage in a separate EIA application for an additional solar farm development.

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 Table 1. The information within this table is based on an average facility size of 200ha for 75MW.
Table 1: Component size and percentage for the proposed 75MWp

<table>
<thead>
<tr>
<th>Component</th>
<th>Estimated extent of each 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>3.1%</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.

Figure 3: A typical layout of a solar PV plant

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 (once “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. The following figure depicts the typical foundation and substructures unto which the frames and PV modules are mounted.

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 technology 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.
Additionally modules can be mounted to the ground by casting 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 10 m. 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 natural washers and avoiding the ecological boundaries set where practically possible.

4. Access road to site

An access road of approximately 6 m 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.

![Figure 6: Typical internal road example](image-url)
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.

![Figure 7: Typical inverter room](image)

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 inverter rooms and the inverter rooms to the on-site substation. These electric cables are planned along internal roads and/or along pathways between the PV/CPV modules as far as possible.

![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 this 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 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 a 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
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 REIPPP. 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, practical 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 Remainder of the Farm 454, Dyason’s Klip (North of the N14). 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 on the farm and a proposed site area of 240ha. 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. It is however noted that the remaining portion of the initial study site not included within this proposed study site, is expected to be used within another new and additional Environmental Impact Assessment for the development of a separate solar PV facility.

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 of the initial study area. 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 within a smaller area. The efficiency of the cells provides benefits relating to capacity per module and reduced spatial requirements and usage. CPV technology systems are much taller than conventional PV technology, with the system reaching a maximum height of approximately 10 m. In some cases CPV installations can require a larger amount of water for cooling purposes, unlike PV panels which only require water for cleaning purposes. However, there are alternative dry cooling methods that do not required additional water.

By using CPV technology the impact on the environment can be seen as slightly higher mostly in terms of the increased 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. Tracking systems will use sun sensors to follow the movements of the sun, combined with mechanical movement the array of solar panels follow the sun for increased production. 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 for the maximum exposure time throughout the day and the year.

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

Table 2 depicts the different advantages and disadvantages related to the two types of photovoltaic technology, described here as PV and CPV technology.

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

<table>
<thead>
<tr>
<th></th>
<th>CPV</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>• Takes up less surface area therefore “footprint” is less, resulting in less impact on soil, agriculture and biodiversity. • More energy can be produced per module. • Because the modules are taller and has a greater separation distance, the ground in between and under the modules are exposed to more sunlight, allowing vegetation to grow back easier after construction.</td>
<td>• Lower visual impact (range between 2 m and 5 m in height). • Lower impact on birds due to lower height. • Lower impact on bats due to lower height. • Easier to erect PV technology. • Lower impact on heritage/ culture due to lower impact on landscape of visual impacts. • Easier to transport.</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>• Higher visual impact, CPV systems can be up to 10 m high. • Higher impact on birds. • Higher impact on bats. • Requires skilled labour because more the structures are more difficult to erect. • CPV systems typically utilises more water than conventional PV. • Higher cultural/ historic impact to the landscape. • Harder to transport – abnormal load.</td>
<td>• PV facilities of the same footprint of CPV facilities produce less power. • 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 as well as the geotechnical qualities and corresponding constraints.
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 240 ha from the 5725 ha property for the purposes of the solar facility will not have a significant effect on these farming activities. A first phase of solar farm developments on the Dyason’s Klip property have however been conducted for RE Capital 3 (Pty) Ltd.; RE Capital 3B (Pty) Ltd and RE Capital 3C (Pty) Ltd. of 600ha. These projects were developed for the purpose of being submitted for the REIPPP 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.

In addition, the environmental assessment practitioners will include an investigation of agricultural consent due to the fact that the development of this project is an additional application and registration of a solar PV facility on the same property, Farm 454, Dyason’s Klip.

### 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 is 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 (including from a Department of Transportation perspective and requirements).

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.

3.3.3 Route alternatives

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.

3.3.3.1 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.
3.3.3.2 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 financers of the REIPPP 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 four 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, or into cleaning equipment (whether moveable or fixed systems). 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 and dust 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. As far as possible, it would be planned to avoid engaging in activities or actions which requires a water use licence, for example the crossing of perennial 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. A full pump-test is expected to be done after preferred-bidder status in order to confirm sufficient water supply potential from the borehole, this will further confirm water availability.

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-100mm. 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.
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 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. If necessary, measures can also be put in place to capture the rainwater runoff from the PV modules with similar solutions.

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 REIPPP 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
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 washers. To avoid erosion in these washers 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 are 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 build 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 through 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 culvert and 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 of the particular situation. A “Causeway” contains openings underneath the surface, which allows passing water through where a “Drift” does not.

![Diagram of LLRC and water flow](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
This section of the report poses to depict and describe the various grid connection options. Figure 20 depicts the various grid connection options pertaining to RE Capital 11 grid connection.

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 Oasis power 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 by means of a self-built line option to the 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.

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 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 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 authorised Eskom Upington MTS 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.

3.5.8 Grid connection discussion
The loop-in option will be most cost effective, but this is dependent on the available capacity of 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 or existing 132kV line is illustrated in Table 3.

<table>
<thead>
<tr>
<th>Alternative grid connection</th>
<th>Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>REC 11 PV PLine Loop in Loop out 01</td>
<td>5.1 km</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 01</td>
<td>9.5 km</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 02</td>
<td>10.5 km</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 03</td>
<td>11.7 km</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 04</td>
<td>9 km</td>
</tr>
<tr>
<td>REC 11 PV PLine Selfbuild 05</td>
<td>20km</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 proposed project site, the Kai Garib municipality, the Orange River or other third party water 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 from the Kai Garib local municipality and transported to the site by standard water trucks, should the borehole water not be sufficient. As stated previously, the boreholes is planned to undergo pump tests after preferred bidder status was received.

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 m$^3$ 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 private independent contractor. 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 MWp 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

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 12-18 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 will be obtained in this regard, should it be required.

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.

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. As previously mentioned, the usage of concrete foundations would be only used if no other foundational options are viable or practical to use.

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.

Figure 22: On-site construction of the PV arrays
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 planned 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 planned MTS substation will be a key substation in the Upington and Northern Cape area.

One of the main purposes of the planned 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 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 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.

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 planned Eskom MTS.
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 25-30 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 re-used 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 25-30 years if the specified periodic maintenance is performed. If financially viable and depending on climate factors in 25-30 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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<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 (Pty) Ltd. 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.
10 Addendum

- Solek company profile
Who we are

Our company Solek was founded in 1988 and has a proven track record of experience and professional service in South Africa. The company has crossed borders and now extends into Africa. Two decades of practical experience, collaboration with local importers and exporters, and internal knowledge defines our capacity. Research and innovation is the heartbeat of the company. Our focus revolves around doing what we do best:

<table>
<thead>
<tr>
<th>Consult</th>
<th>Supply &amp; Design</th>
<th>Partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide key knowledge to meet our client demands</td>
<td>Design systems, source and supply products &amp; technology</td>
<td>Collaborate with key partners to extend our reach</td>
</tr>
</tbody>
</table>

What we do

Over the past few years, Solek has expanded its services and now operates in the following departments:

- **Systems and Sales**: Engineering, procurement and construction of grid-tie and off-grid solutions in residential, industrial, commercial and agricultural sectors.
- **Energy Efficiency**: Providing sustainable energy efficiency services such as load management, process optimisation, renewable energy replacement technologies, energy audits and energy management systems.
- **Project Development**: Project development services for the development of utility-scale projects (solar & bio-energy), ensuring viable project development in terms of legislation approvals, off-take and supply agreements, and project management.

Resource network

Partnering and long-term relations are the business approach we value. Ongoing partnerships with well-established solar companies provide added resources which the company can tap into. Broad expertise and man-power are available if needed. The aim is to support and collaborate rather than compete.

Experience

- **Branches**: Western Cape office houses the core engineering team, supported by a branch in Loeriesfontein, Northern Cape.
- **eta Awards**: Received a Special Award sponsored by Eskom and the Department of Energy in 2011 for the Kleinmond EPC.
- **PV off-grid systems**: Two-decade client base: hundreds of clients in Northern Cape and elsewhere give evidence of the company’s success.
- **Mitchell’s Plain grid-tie design & EPC**: Design, supply and installation of a 64kWp grid-tie solar PV system to offset a portion of the electricity consumption of a Provincial Hospital in Mitchells Plain, Western Cape, in 2012.
- **Energy efficiency & audits**: Conduct energy audits to identify energy saving opportunities and develop energy efficiency projects under Eskom IDM subsidy programmes. Recent projects: retail stores, office parks, wine cellars and estates (e.g. Val de Vie Winelands).
Kleinmond EPC  
Design, consulting and procurement of solar PV and solar water heaters for over 400 low-cost houses in Kleinmond.

Utility-scale solar projects  
Co-development of three solar farms, totalling 150 MW, covering more than 300 hectares of farm land for the REIPP Tender Scheme.

Sawmill feasibility study  
Solek conducted a feasibility study in 2013 for the expansion of existing operations at a sawmill. The scope of the study was restricted to kilns, boilers and co-generation.

Engen Namibia  
Three (3) kWp grid-tie PV system for Engen Namibia to provide base load power for evaporative air-cooling units.

2 MW Biogas project  
As co-owners, developed a 2 MW biogas project at one of the biggest cattle feedlots in South Africa, KwaZulu-Natal. This includes CDM registration.

Angola off-grid project  
Consultants and sub-contractors to supply, install and train solar installations on 120 schools & clinics.

Angola village systems  
Consulted and supplied solar cells, battery and inverter systems to small households in Angola.

Land identification & screening  
Land identification and site screening of more than 20 solar farms for and on behalf of international clients.

Lesotho & Mozambique  
System design and supplying of solar water pumping solutions for clients in Mozambique and Lesotho.

Expertise  
The heart of the company beats with many years’ experience. Engineering knowledge including master-degrees and related qualifications extend management arms. Industrial engineering together with our sought-after technical and electrical know-how boost efficient operations help manage extending projects and deal with sourcing and supply issues.

Supplier support  
Solek focuses on long-term customer value. Only quality products are supplied backed by major suppliers for support and warranties, locally and abroad. This provides a knowledge base and strong competitive advantage which differentiate Solek from other solar companies. Products supplied by Solek have proven to last 15 years and more, thus enduring harsh African conditions.

Consulting  
Owing to our experience, the company engages in risk assessment, quality assurance and project due diligences. Typically, tenders can be evaluated to ensure the right products are supplied, system design is correct and margins acceptable based on industry models. The company has extensive experience in hybrid and off-grid systems design, providing optimal performance at minimal cost.

Innovation & Research  
The company has a track record of innovative ideas. An entrepreneurial spirit boosts performance to deliver inventions and solutions beyond expectations. Research and development reinforce our long-
term focus and Solek collaborates with Stellenbosch University as well as Cape Peninsula University of Technology. Products have been patented and released to the market.

**Value-added service**

In addition to consulting and technology supply, services such as project management, installation and post-installation services are provided. To improve energy efficiency services, we registered at Eskom as an ESCO in order to conduct energy audits. A lifecycle approach ensures longevity in the solutions we implement and a single sub-contractor to outsource various functions to.

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**Project Management Function**

- Consult Client
- Develop Solution
- Source & Supply
- Implement & Install
- Service & Maintain

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**Legacy**

As part of our business model we believe industry has to touch lives. The vision of the company ensures that resources are committed beyond monetary value to affect society. Projects have been initiated to serve the less privileged through inventive ways and thousands have been influenced already. The company dedicates its knowledge and expertise to effectively reach this goal.