



**AFRICAN DEVELOPMENT  
BANK GROUP**

**PROJECT : CONSTRUCTION OF THE BOKHOL SOLAR PHOTOVOLTAIC  
PLANT IN SENEGAL**

**COUNTRY : SENEGAL**

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**SUMMARY OF ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)**

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<b>PROJECT NAME</b>	<b>: BOKHOL SOLAR PHOTOVOLTAIC POWER PLANT CONSTRUCTION PROJECT IN SENEGAL</b>
<b>COUNTRY</b>	<b>: SENEGAL</b>
<b>SAP CODE</b>	<b>: P-SN-FF0-001</b>
<b>DEPARTMENT</b>	<b>: OPSD</b> <b>Division: OPSD.3</b>

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## **1 INTRODUCTION**

This document is the summary of the Environmental and Social Impact Assessment (ESIA) of the Bokhol Photovoltaic Power Plant Construction Project in Senegal. The project is classified in Environmental Category 2. Pursuant to Bank and country environmental policy requirements, the ESIA was prepared in 2015 in the project area and submitted for the approval of the Senegalese Ministry of Environment.

This summary was prepared on the basis of the ESIA provided by the sponsor, in accordance with Senegal's environmental requirements and the African Development Bank's Integrated Safeguards System.

The project description and rationale are first presented, followed by the legal and institutional framework in Senegal. Then, the description of its main environmental conditions is presented along with options compared in terms of technical, economic, environmental and social feasibility.

Environmental and social impacts are summarised and inevitable ones identified. Measures to improve and mitigate the negative impacts are also presented. The outcomes of public consultations held during ESIA and for the project itself in its target area, as well as complementary project-related initiatives are equally presented. The conclusion evokes the project's acceptability (an Environmental Compliance Certificate has been issued in the country) and the Environmental Supervision and Monitoring Programme disseminated on the sponsor's website in Senegal.

## **2. PROJECT DESCRIPTION AND RATIONALE**

The project aims to construct, operate and maintain a 20 MW photovoltaic power generation plant in Bokhol commune, in the North of Senegal. The power plant will use poly-crystalline photovoltaic modules and occupy a 50-hectare site. It will be connected to the SENELEC grid by underground transmission lines linked to an existing MV/HV transformer situated nearby less than 75 m from the site.

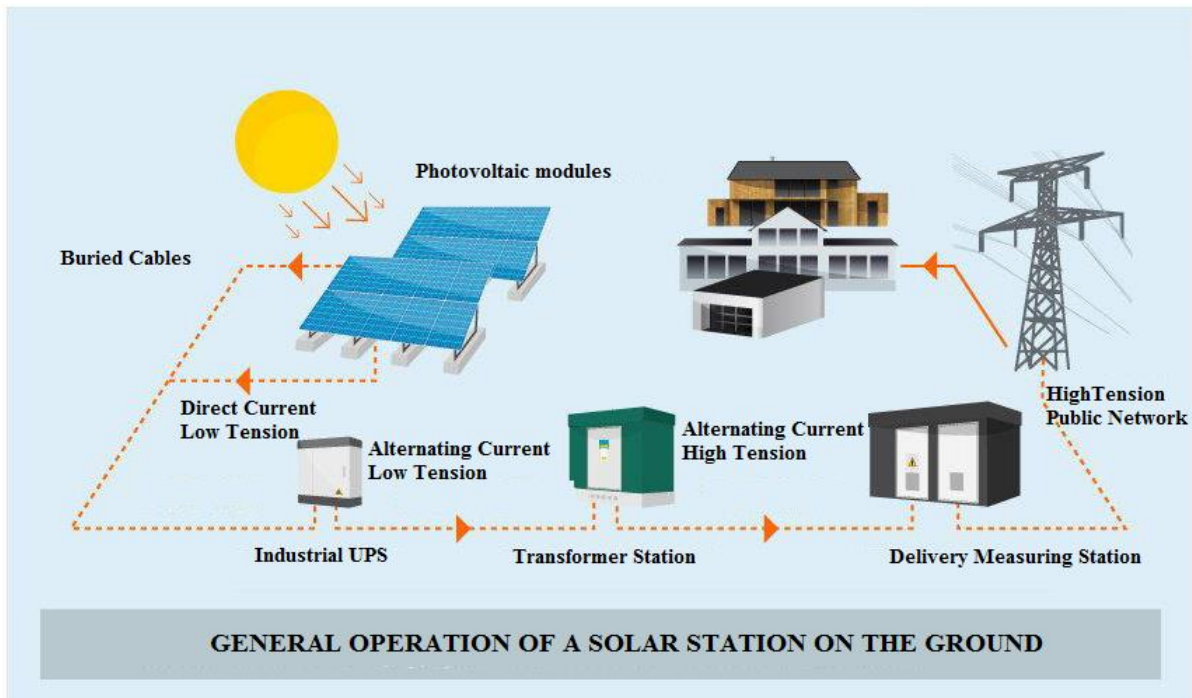
The project components are: (1) Construction of a 20 MW solar plant; (2) Construction of a 75 m transmission line; (3) Procurement and installation of necessary equipment; and (4) Project management.

The project is jointly developed by GreenWish and SENERGY 2, which will form a special purpose vehicle (SPV) for its implementation. The purpose of the Power Purchase Agreement (PPA) signed between SENERGY 2 and SENELEC is the construction, operation and maintenance of a 20 MW plant for the production of electricity of photovoltaic (PV) origin in Bokhol commune, in the North of Senegal.

The plant will use poly-crystalline photovoltaic modules and occupy a 50-hectare site. It will be connected and commissioned in November 2016. In March 2015, SENELEC confirmed the project by signing a first additional clause to the Power Purchase Agreement and by requesting the Ministry of Finance to surety its commitments, which was granted in April 2015. This is the first solar IPP project in the country following a wide invitation to bid published by the Government in 2012 for the promotion of renewable energies.

The schematic diagram below illustrates a system of generating electricity via solar procedures as is the case with the Bokhol Solar Photovoltaic Plant:

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The total project cost is estimated at EUR 26.23 million, 90% of which represents CAPEX costs.

### 3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

#### Senegalese Policy and Regulatory Framework

In Senegal, the environment is a top priority in the Senegal Emergence Plan (*Plan Sénégal Emergent - PSE*). The country's regulatory framework is directly linked to and/or associated with the environmental and social themes of the African Development Bank's Integrated Safeguards System (ISS). It rests primarily on the Constitution of 22 January 2001 which guarantees in its Preamble and Section 8, the right of every citizen to a healthy environment. Senegal's policy framework comprises two guidance and planning papers: the National Environmental Action Plan (PNAE) and the Letter of Environmental Sector Policy (LPSE).

In the LPSE, Senegal undertook to incorporate sustainable development principles in national policies and to reverse the observed trend towards environmental resource depletion.

The legislative framework in Senegal comprises: (i) Law No. 2001-01 of 15 January 2001 instituting the Environmental Code; (ii) Implementing Decree No. 2001-282 of 12 April 2001; and (iii) measures to strengthen these instruments through Orders No. 009468/MJEHP/DEEC regulating public participation in ESIA; No. 9469/MJEHP/DEEC relating to the operation of the technical committee; No. 9470/MJEHP/DEEC on the conditions for the issuance of authorization to carry out ESIA-related activities; No. 009471/MJEHP/DEEC relating to the contents of the terms of reference of ESIA; No. 009472/MJEHP/DEEC relating to the content of the ESIA report. Therefore, OS1 requirements are covered.

Law No. 76-66 of 2 July 1976 instituting the State Land Code, Law No. 64 of 17 June 1964 instituting national land and its accompanying instruments, Law No. 76.67 of 02/07/76 on expropriation for public interest, Law No. 2008-43 of 20 August 2008 instituting the Town Planning Code and Law No. 2004-16 of 4 June 2004 which lays down guidelines for Agricultural, Silvicultural and Pastoral activities (LOASP), together constitute the legal framework governing resettlement and meet OS2 requirements.

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Furthermore, Law No. 86 - 04 of 24 January 1986 instituting the Hunting and Wildlife Protection Code; the National Action Plan to Combat Desertification (PAN/LCD); the National Strategy on Biodiversity Conservation; the National Climate Change Implementation Strategy (SNMO) as well as Law No. 98-03 of 8 January 1998 on the Forestry Code, as supplemented by Implementing Decree No. 98-164 of 20 February 1998, etc. govern biodiversity conservation, in line with AfDB OS3.

In addition, Law No. 2001-01 of 15 January 2001 instituting the Environmental Code and its implementing instruments; Law No. 81-13 of 4 March 1981 instituting the Water Code; the NS 05-061 Standard on waste water discharges on July 2001, and discharge-related standard NS 05-062 on atmospheric pollution all meet AfDB OS4.

The OS5 requirements are principally met in: (i) the Labour Code through Law No. 97-17 of 1 December 1997 laying down labour conditions and its implementing decree (working equipment, surrounding physical factors, industrial medicine, etc.); (ii) Law No. 83-71 of 5 July 1983 on the Hygiene Code; and (iii) international treaties ratified by Senegal related to child protection and forced labour.

### **Senegal's Administrative and Institutional Framework**

Several national, regional and local institutions and structures are involved in environmental protection, albeit with different roles. They include technical State services but also non-State actors and local authorities.

- The *Ministry of Environment and Sustainable Development (MEDD)* comprises directorates, three of which are important for environmental policy implementation in Senegal: the Directorate of National Parks (DPN); the Directorate of Environment and Classified Establishments (DEEC); and the Directorate of Water, Forestry, Hunting and Soil Conservation (DEFCCS). DEEC coordinates different services as well as DEFCCS.
  - The *Ministry of Power and Renewable Energies (Directorate of Electricity)*, which implements the policy defined by the Head of State in the areas of power generation/distribution and the promotion of renewable energies. In particular, it prepares power-saving and alternative-energy development plans and programmes that can lead to a substantial reduction of the burden of conventional energies – oil, gas and coal – on the national economy. It ensures the adequacy of specific technological choices with solar, hydro and wind power sources, liaising with the ministries concerned to enhance the value of scientific and technological achievements.
  - The *Ministry of Local Governance, Development and Regional Development*, which prepares and implements the policy adopted by the Head of State in the areas of decentralisation, territorial governance, physical planning and development. It ensures the seamless, balanced and coherent development of urban centres and economic activities nationwide.
  - *Bokhol Commune*, which has the following powers: the management of the terms and conditions for exercising customary rights within the council area, subject to exceptions under the law; the drafting and management of the general land occupancy plan, projects for the development, parcelling, equipping of land allocated for residential use as well as the grant of authorisation for the construction of residential houses or camps; management of the allocation or otherwise of national land; local projects and council participation in their financing; human investment projects; management of easements and open pasture land.
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**African Development Bank’s Policy and Regulatory Framework**

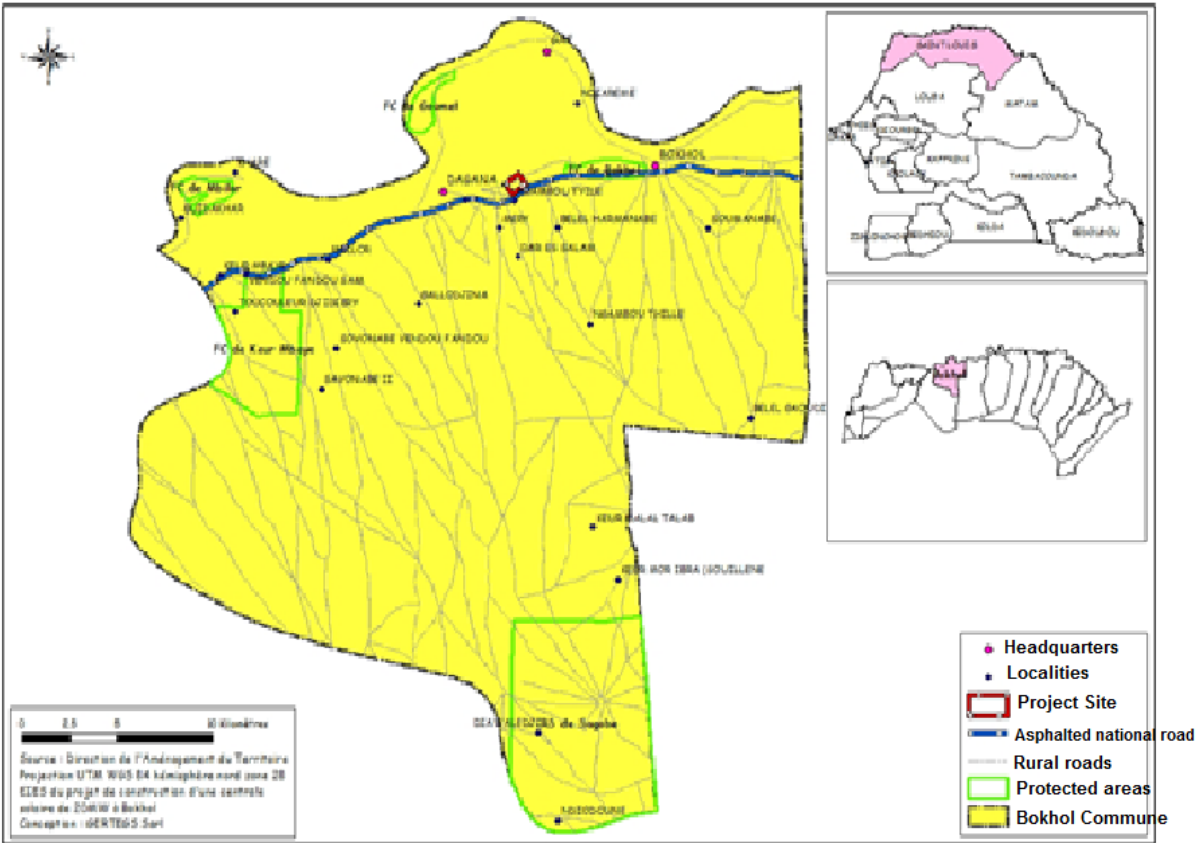
For AfDB, this involves the 2014 Integrated Safeguards System (ISS) under five operational safeguards: Operational Safeguard 1 (OS1) on Environmental and Social Assessment; Operational Safeguard 2 (OS2) on Involuntary Resettlement, Land Expropriation, Population Displacement and Compensation; Operational Safeguard 3 (OS3) on Biodiversity and Ecosystem Services; Operational Safeguard 4 (OS4) on Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resources; and Operational Safeguard 5 (OS5) on Labour Conditions, Health and Safety.

Other applicable AfDB guidelines and policies are: (i) the Gender Policy (2001); (ii) the Framework for Enhanced Engagement with Civil Society Organisations (2012); (iii) the Disclosure and Access to Information Policy (2012); (iv) the Policy for Integrated Water Resource Management (2000); (v) the Climate Risk Management and Adaptation Strategy; and (vi) the Environmental and Social Assessment Procedures for African Development Bank’s Public Sector Operations (2015).

**4. PROJECT ENVIRONMENTAL AND SOCIAL CONTEXT**

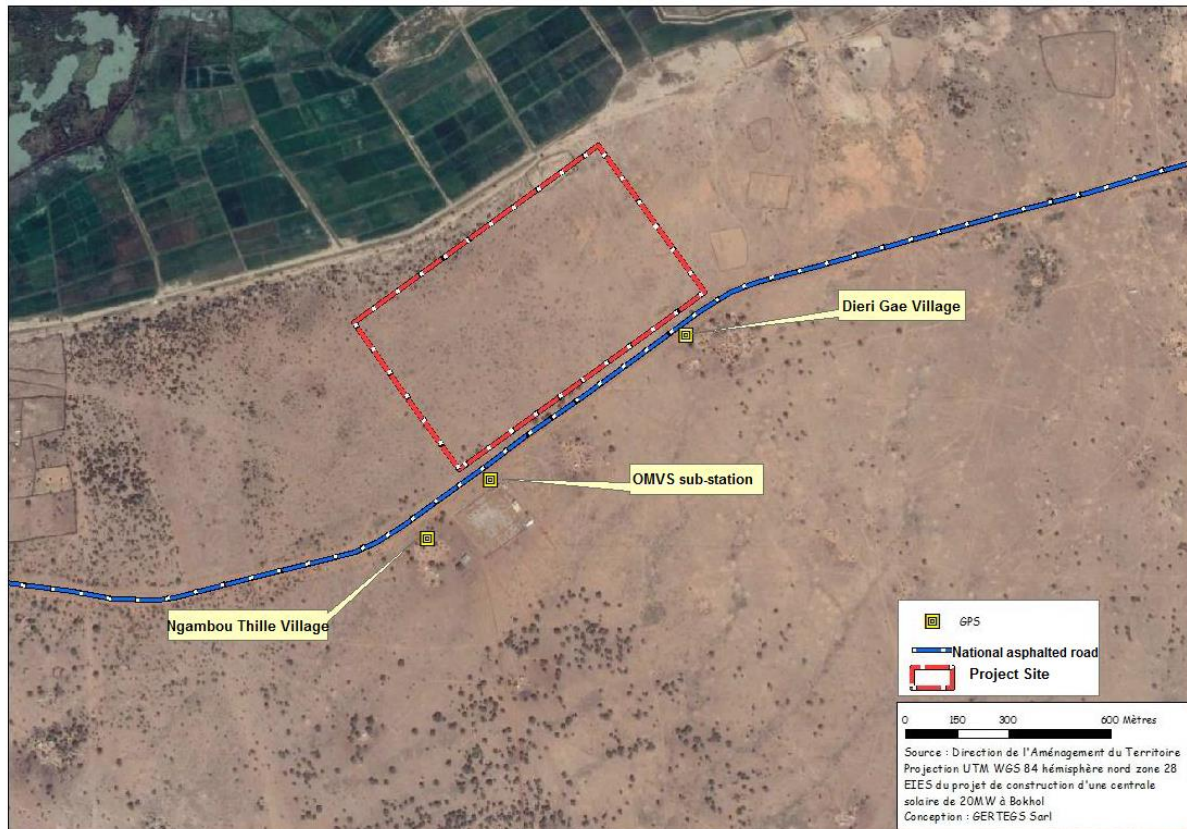
**Project Target Area**

The project’s direct target area covers the Bokhol Commune situated in Mbane Subdivision (“*arrondissement*”), Dagana Division (“*Département*”), Saint-Louis Region of Senegal. Bokhol Commune is bounded: (i) to the North by the Senegal River; (ii) to the East by Fanaye Commune; (iii) to the West by Richard-Toll and Mbane Communes; and (iv) to the South by Mbane and Fanaye Communes.



The site on which the photovoltaic power plant will be built is bounded: to the North by the Dagana Basin; to the South by National Road 2 (RN2); to the West by private land; and to the East by empty (unoccupied) space.





## Physical Environment

Climate data comes from the Saint-Louis reference station. Temperature, rainfall and winds are climatic factors that most determine the climate of the area.

### ☞ Rainfall

The area has a Sahelian-type climate marked by scanty rainfall with high annual variations and two distinct seasons: (i) the rainy season from July to October with maximum rainfall in the months of August and September; and (ii) the dry season from November to June.

Rainfall in the North is marked by a West-to-East gradient between the Saint-Louis and Dagana Divisions. From an annual average of 330 mm in Saint-Louis, rainfall averages about 315 mm in Dagana.

### ☞ Temperature

Temperature has a strong influence in the arid inter-tropical zone. The project area is marked by high temperatures ranging between 26°C and 40°C, and an average of 35°C.

### ☞ Relative Humidity

Maximum relative humidity is lowest between November and April and is associated with the presence of the East flow. As from April, values increase to a maximum in August due to the presence of the West flow. The minimum is observed between January and May. The maximum relative humidity follows the same trend with a minimum in March and a maximum in August.

### ☞ Sunshine duration

Sunshine duration values reach maximum in March, April and May while minimum values are recorded in December-January. The relatively low values observed in July-August-September are due

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to the rainy season. High values correspond to very high temperatures and inversely low values to low temperatures.

The sunshine duration in the project area may exceed 3,000 hours per year with a daily average of about 8 hours.

#### ☞ **Winds**

Three (3) dominant wind directions are observed in Saint Louis Region: Northward, West-North-Westward and North-North-Eastward.

North-to-North-Westerly winds dominate in this part of the country as well as the northern maritime trade winds from the Azores Anticyclone, cooled by the Canary currents. This causes relatively cool temperatures, low thermal amplitudes and constant humidity occasioning frequent dew.

From June until September, the winds blow mainly from North-West to the West. This wet monsoon wind is responsible for the rainfall observed in Saint Louis.

### **Biological Environment**

#### → **Sensitive Zones**

The project site does not encroach on any sensitive zone, but Bokhol Commune hosts four classified forests (CF) and one sylvo-pastoral reserve (RSP) which are out of the project target area. They are distributed as follows: Keur Mbaye CF (2,400 ha); Mbilor CF (3 ha), Bokhol CF (3 ha); and Goumet CF (3 ha) and the Sylvopastoral Reserve (3,400 ha). Given the considerable distance of these sensitive areas, this component poses no challenge for this project.

#### → **Biological Milieu**

The project site is located in the “Diéri” sub-zone where the forest vegetation is dominated by *Acacia senegal* (“werek”) and *Acacia raddiana* (“séeng”). In contrast, below the rise of the continental terminal often hidden by a layer of slightly clayey sand, it is mainly *Acacia nilotica* var. *Adansonii* (“nebneb”), *Acacia seyal* (“suruur”) and *Combretum glutinosum* (“rat”) that develops.

The project site and areas likely to be affected (within a radius of one (01) kilometre) host a Sahelian steppe vegetation with trees and shrubs with a predominance of thorny xerophytes, with low coverage and/or density (see photograph below).

#### ☞ **Floral Composition**

The inventory conducted on a site measuring one (1) km in radius allowed for the identification of 19 species, distributed in nine (09) families.

#### ☞ **Mammalian Wildlife**

Large Fauna: Although no species belonging to this group was encountered during the prospection mission, the literature mentions the presence of hyenas and warthogs. Environmental fragmentation and habitat degradation no longer allow for the development of large wild fauna.

A rather non-diversified group, small fauna is mentioned in the literature. A few species (jackals, i.e. *Canis adustus*), squirrels (*Siurus vulgaris*), civet cats (*Gnetta gnetta*) and rabbits (*Lepus crawshayi*) are endemic to this kind of milieu.

#### ☞ **Bird Fauna**

Wild life is dominated by birds. The Senegal Delta is one of the largest food-rich wetlands situated in the immediate border of the Sahara Desert. Numerous palearctic migratory birds mostly *Anatidae*, herons/bittens and waders/gulls/auks (such as white pelicans, cormorants, night herons, white-faced tree ducks, the glossy ibis, the greater flamingo and the lesser flamingo) nest there.

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### ☞ **Reptilian Fauna**

Birds co-exist with reptiles such as *varanus niloticus*, boas in the river zone and agamids on higher ground above flood plains.

### ☞ **Amphibian Fauna**

Because of seasonality, no information is provided in this section. Nevertheless, temporary ponds are known to harbour amphibian species such as frogs and certain fish species.

### ☞ **Insects**

Insects form the largest systematic group of the study. Their strong presence stems from the development of agro-systems.

### **Human Environment**

The population of Bokhol Commune in 2013 was estimated at about 16,801 people (ARSD), including 8,367 women or 49.80% of the population. The Commune has 2,305 compounds averaging 9.5 people per compound, and 2,894 households averaging 7.5 people per household (PLD, 2010).

The closest human settlements to the plant site are: Ngambou Thillé village, Diamlawaly village and Chez Samba Thiafaly village. These 3 villages are inside the project's direct target area.

The project site is unoccupied, but the land had been intended mainly for agro-pastoral purposes. Due to the shortage of rainfall noted these last two years, it is no longer used for rain-fed agriculture and pastoral activities.

**Education:** Bokhol Commune has no early childhood sub-sector infrastructure despite its relatively large target population (0 – 5 years) estimated at close to 3,500 children, representing about 16% of the population.

The sustainable development of elementary education in the *Haut Diéri* area is very difficult not only because villages are small and far-flung but mostly because of the harsh living conditions (lack of water, inadequate health services and housing), which prompt staff in service in the zone to apply for transfer elsewhere and even abandon their posts. In fact, only 28 of the 38 villages in the council area fulfil the criterion of access relative to distance (at less than 2 km to an elementary school), which corresponds to an access rate of 74%. Currently, there are 2,546 pupils - 1,364 of them girls (53.6%) - in the primary schools of the commune out of a population of school-going age (7 – 14 years) estimated at 4,100, corresponding to a gross enrolment rate (GER) of about 63%. Therefore, Bokhol Commune is far short of the average regional GER evaluated at about 95% in 2010.

The commune's two junior secondary colleges (CEM) are located in Bokhol 1 and Keur Mbaye zones. The Bokhol CEM has an enrolment of 406 students, including 223 boys (55%) and 183 girls (45%). Girls are in the majority in the seventh grade ("6<sup>ème</sup>") but represent only 27% of enrolments in the tenth grade ("3<sup>ème</sup>"). Special initiatives should be taken to accompany girls to complete the junior secondary cycle.

Bokhol Commune has 21 *daaras* (Arabo-Quranic education) whose enrolments range from 5 to 120 students coming from Saint-Louis and other regions of the country such as Diourbel, Kaolack, Louga. In addition to inconvenient study conditions, most *daaras* are found in villages where there is neither running water nor health structure.

There are no vocational and technical training structures in the commune.

No literacy initiative is noted in Bokhol Commune. However, the establishment of village development committees revealed that a number of villagers were literate. By relying on these organisations, which bring together all types of rural community organisations, it will be possible to conduct a literacy programme to reach the right targets and reduce the illiteracy rate.

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**Health:** Bokhol Commune has three (3) primary health centres, three (3) health outposts and two (2) maternities that are unequally distributed across its various geographic zones. Bokhol 1 zone has a health outpost, one maternity and one primary health centre, and Guidakhar zone one health outpost and one primary health centre. Mbilor zone has one health outpost and one maternity but Keur Mbaye has only one primary health centre. The Méry and Souylène zones, for their part, have no health infrastructure.

56% of Bokhol Commune population have access to a health outpost. In other words, they are at less than 5 km from the infrastructure. However, this average hides significant disparities among the six zones of the commune. In fact, Guidakhar, Mbilor and Méry zones with access rates of 100%, 94% and 77%, respectively, remain largely covered whereas Souylène and Keur Mbaye each record rates of 0%. The access rate in Bokhol 1 is 58%.

**Drinking water and sanitation:** With a population of 21,833 living in 38 villages, Bokhol Commune has 32 wells, 241 private standpipes, 13 public standpipes and 3 drinking water stations located in Bokhol, Guidakhar and Kharé. Bokhol's is the largest and in addition serves Belel Gawdi and Keur Birane villages. Thus, 5 villages totalling 6,985 inhabitants (32%) have access to drinking water in the commune. The problem of access to drinking water is acute in localities of *Haut Diéri* where the populations suffer most from consequences linked to the far-flung location of water points.

The inventory of community latrines reveals an imbalance in spatial distribution. The Bokhol and Mbilor zones are well covered in private latrines while the rest of the commune is deprived apart from a few households in Méry and Keur Mbaye. Public latrines, which are expected to offset the lack in households, are far from covering the commune, with seven (7) units concentrated in the Keur Mbaye and Mbilor zones. This inventory reveals a low coverage rate of 32%, corresponding to 12 villages with a population estimated at 11,786 people. Thus, the population's rate of access to latrines stands at about 54%. This rate is acceptable compared to the national average of 55%.

**Local economy:** The Bokhol Commune economy rests on agriculture (70%) and livestock (30%). Formerly, the commune was a production pole of cereals, the principal product being millet and foodstuffs like *niébé*, maize and sweet potato. It was such a major pole of agricultural production that, after harvests, big traders would flock there from Saint-Louis via the River and from Djoloff.

That agriculture involved flood plain cultivation along the river and rain-fed farming. Each family earned income from it and had a *sakh* (granary or stock) for their subsistence for at least one year. Off-season farming, commonly called floodplain cultivation, dominates in the project area. The site is situated at variable distance of between two hundred (200) and less than twenty (20) metres from the Dagona Basin. It has an exploitable area of two thousand (2,000) hectares operating with three (03) "bucket" boreholes.

Inland fish production on the river largely covered the population's fish needs and the surplus was processed into the local delicacy "*guedj*" (dried fish).

Livestock, which had all the necessary conditions for its development, produced milk in quantities that far exceeded local needs.

Forestry, for its part, provided products of gathering and hunting that could satisfy all the human and animal demand for food.

**Energy services:** Energy services are from diverse sources including electricity, gas, charcoal, firewood and diesel. Electricity is available only in 3 villages: Bokhol, Mbilor and Keur Mbaye. This gives an access rate of about 30% considering the population size of these villages. This energy is supplied by the SENELEC grid and principally serves for public and domestic lighting.

**Situation of women in the project area:** Although women are highly present in production circuits, their role is not yet commensurate with their engagement, due to the lack of resources and difficulties

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they encounter in accessing means of production. Bokhol women are active in several economic sectors. Some work in agriculture and market gardening, while others are engaged in stockbreeding and processing activities. Among the *Wolofs*, both women and men work and all have access to land. But things are different among the *Peulhs* where only men have the means of production and women virtually cannot demand any. The only alternative for *Peulh* women is to collect the post-harvest residues after the men have harvested. The following table presents a summary of the situation of women in the project area:

Men	Women
<b>Access to landed property</b>	
Over half of household heads have land with average areas of between 2 and 5 ha	About 5 % of women have land, on average 0.5 ha per person
<b>Activities undertaken</b>	
Rice cultivation; market gardening; stockbreeding; fishing	Rice cultivation; market gardening; stockbreeding; agroforestry
<b>Community activities</b>	
Vocational organisations EIGs Religious organisations	Women's promotion groups Involvement in virtually all village community organisations and activities
<b>Access to means of production</b>	
Operators generally have production equipment and obtain substantial bank loans to procure the necessary inputs for their farms	Access to means of production is relatively limited for women because they often lack land to farm. Due to land insecurity, they do not take the risk to invest in agricultural equipment and inputs
<b>Financial resources</b>	
Men have access to financial resources because they have guarantees, especially their resources. Loans are up to 5 million and even more.	Women contract loans via their groups. Their only guarantee is the group
<b>Decision-making bodies</b>	
At the level of municipal councils, representation is slightly to men's advantage, which contrasts with the situation previously when male domination in decision-making bodies was virtually total.	24 men for 22 women in the Bokhol municipal council Low representation of women in apex organisations.
<b>Support of community organisations</b>	
Training on access to financing Access to financing Supervision to improve production Development of irrigation schemes	Training in reforestation and dyeing techniques
<b>Roles at the household level</b>	
Household costs are shared between men and women	Women cater to house embellishment costs, supplement the food budget; they also cover the cost for their dressing and that of the children

## 5. PRESENTATION AND SELECTION OF PROJECT OPTION

The project will add 20 MW to the installed capacity and boost the country's power generation capacity. With annual production of at least 34 GWh, the Bokhol solar power plant will help to connect 200,000 new consumers to the national grid.

### **“No project” scenario**

**The “no project” scenario** – equivalent to not installing the solar power plant and maintaining the status quo in terms of the use of the land – causes several negative effects:

- Lateness in absorbing the electricity production deficit nationally and in reducing costs and per-KWh tariffs, thereby contributing to the financial imbalance of SENELEC, the lack of competitiveness of the Senegalese economy and a negative impact on household economy;

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- The community has no opportunity to access the private sector's social investments, which could, among other things, help to further enhance the value of productive land and improve: (i) the population's resilience to climate change; (ii) access to electricity; (iii) infrastructure and the quality of basic social services, etc., and local tax resources;
  - No opportunity for the State to access tax resources and promote a profitable investment of sovereign funds ;
  - The absence of socio-economic development of degraded lands in a context where the population's capacity is weak in terms of resilience to the effects of climate change;

This scenario neither corresponds to nor complies with Senegalese Government policy. It is also not consistent with the country's economic and social development objectives.

Hence, the "no-project" scenario would not only contradict the spirit and principles for the improvement of energy in Senegal but would also deprive communities of access to sustainable electricity and consequently resilience to climate change.

The main advantage of the no-project variant, namely preservation of land use values, may be restored, even improved, through the implementation of compensation measures (compensation of biodiversity, compensation linked to land use restrictions, etc., and social support measures.

### **Project Alternatives**

The alternatives explored concern the choice of site, the method of production and the choice of type of renewable energy.

For the **site variant**, the choice can be justified:

- Technically and financially, by: (i) the closeness of the SENELEC sub-station to inject the electricity generated into the grid, a strong environmental and social argument since no new network has been created; and (ii) the significant amount of sunshine;
- Socially and institutionally, by: (i) the existence of an agreement between the commune and the developer and its validation by the administrative authorities; (ii) the social acceptability of the project by the people of Bokhol without exception; (iii) the bridging of regional disparities in the production of photovoltaic solar energy (one of the objectives of the Letter of Energy Sector Development Policy); (iv) the project site being free from any occupation; (v) the soil quality, which is a major constraint in land exploitation for agricultural purposes.

One of the main constraints related to the site is natural pollution due to terrigenous erosion, which will require that solar panels be cleaned more frequently. Since this constraint can also negatively affect equipment, it was properly considered under the criteria of choice of equipment and in the operating conditions of the power plant.

With regard to the **production method** variant, it is worth noting that renewable energies have several advantages including:

- Contribution to the diversification of production sources;
  - Contribution to an increase in the rate of energy independence from 4% in 2004 to 20% in 2020 (Letter of Energy Sector Development Policy), etc.;
  - Reduction of GHG emissions at national level;
  - Low operating costs; and
  - Lower rate of production of hazardous wastes.
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The main constraint for solar energy, which also holds true for the other renewable energies (RE-ERNs), is that it takes up much space.

Consequently, the core challenge in environmental and social feasibility is the attendant loss of land. However, through the status report of soil resources and especially measures aimed at offsetting the usual functions and even at strengthening socio-economic and resilience capacity, this challenge can be mastered and even transformed into an opportunity.

From the range of renewable energies, the final choice fell on photovoltaic solar power due to the weather conditions of the host site procured by the developer, the technical capacity existing nationally, the country's experience in this sector and options defined in the Letter of Energy Sector Development Policy.

### **Option Selected**

The option selected for this project was PV solar power, considering the goal pursued (production and sale of electricity to SENELEC, which holds the monopoly of purchase) and Senegal's experience in solar PV power.

The photovoltaic market is dominated by mono-crystalline and multi-crystalline (sometimes called poly-crystalline) silicon tranche technologies (including ribbons-based technologies) with a market share of about 80% in 2009. The optimum outputs of various types of cells is up to over 40% for GaAs concentration cells, about 25% for mono-crystalline silicon, 20% for multi-crystalline silicon and CIGS, 17% for CdTe and about 10% for amorphous silicon.

The project chose poly-crystalline panels for better value for money. They come in square cells (mono-crystalline panels have squared sides) to allow for better bulking in a module and good conversion output (about 100 Wc/m<sup>2</sup>). However, where lighting is poor, the output of poly-crystalline panels is low. Mono-crystalline panels have good output, 150 Wc/m<sup>2</sup> or higher, but their cost is higher.

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## Description of Scope and Assessment of the Sensitivity of Environments Crossed

The following table summarises the scope and sensitivity of environments crossed.

Themes	Characteristic of the Project Area		Assessment of Challenge		Compatibility with the Project	
Climate	<ul style="list-style-type: none"> <li>☞ <i>Very sunny zone with an annual average that exceeds 3,000 hours</i></li> <li>☞ <i>Zone with low rainfall (annual average 330 mm)</i></li> <li>☞ <i>The atmosphere is under the influence of the North wind (charged with solid pollutants) during the entire dry season</i></li> </ul>		<b>H (P)</b>		Annual sunshine in the project area slightly exceeds 3,000 hours Variable daily sunshine: minimum sunshine in June (7.4 hours), maximum sunshine in April (9.5 hours)	
			<b>A (N)</b>		Project area subject to the terrigenous Northern wind (wind erosion)	
Geology	<ul style="list-style-type: none"> <li>• <i>The geology of the study area forms part of the global geology of the Senegalo-Mauritanian secondary and tertiary basin</i></li> </ul>		<b>H (P)</b>		Compatible substrate to receive infrastructure (piling and operating building)	
Pedological resources	<ul style="list-style-type: none"> <li>☞ <i>Substrate (soil) on site and surrounding environment, is of the sandy "Toldé cénal" type</i></li> <li>☞ <i>Soils poor in organic matter and very sensitive to wind and water erosion</i></li> </ul>		<b>W (N)</b>		Soils poor in organic matter: very high infiltrability Soil compatible with agricultural and pastoral activities	
Surface water	<u>Distant Zone</u> <ul style="list-style-type: none"> <li>☞ <i>The river system rests on the Senegal River</i></li> <li>☞ <i>Absence of perennial water courses</i></li> </ul>	<u>Site and Detailed Zone</u> <ul style="list-style-type: none"> <li><i>No perennial water body</i></li> </ul>	<b>W (N)</b>	<b>None</b>	Water for agricultural use and drinking  Living environment of numerous animal and plant species	No use
Ground water	<ul style="list-style-type: none"> <li>☞ <i>No form of ground water use is observed on the site and its surrounding milieu (neighbouring villages served by the water supply scheme)</i></li> <li>☞ <i>The superficial water table under the site is harnessed at less than 45 metres</i></li> <li>☞ <i>Three aquifers are harnessed in the project sector: Continental Terminal, Eocene and Maestrichtien</i></li> </ul>		<b>A (P)</b>		No form of ground water use is observed on the site and its surrounding environment  The water supply scheme crosses Ngambou Thillé and Dieri Gaé villages	
Biodiversity	<ul style="list-style-type: none"> <li>☞ <i>Site not favourable for wildlife development and preservation</i></li> <li>☞ <i>Disparate vegetation: virtually non-existent</i></li> <li>☞ <i>Natural milieu completely degraded on the site and areas</i></li> </ul>		<b>W (N)</b>		Vegetation on the site is disparate Presence of four (04) species ( <i>Ziziphus mauritanian</i> , <i>Tamarindus indica</i> , <i>Faidherbia albida</i> and <i>Acacia radiana</i> ) which are: (i) partially protected by Senegal's Forestry Code; and (ii) threats	



<b>Themes</b>	<b>Characteristic of the Project Area</b>	<b>Assessment of Challenge</b>	<b>Compatibility with the Project</b>
	<i>likely to be affected</i> ☞ <i>Site located in the “Diéri” section</i>		to the flora of Senegal.
		<b>A (N)</b>	Large fauna virtually non-existent Presence of highly diversified bird fauna  Poorly diversified small fauna
<b>Sensitive areas</b>	☞ <i>Project area does not intercept any sensitive zone: classified forest (CF) and sylvo-pastoral reserve (RSP)</i>	<b>H (P)</b>	The project site is very far away from sensitive zones The site and environments likely to be affected are not sensitive zones
<b>Socio-economic activities</b>	☞ <i>No socio-economic activity is identified on the project site</i>	<b>H (P)</b>	Establishing the project will not lead to any cessation of activity
<b>Human environment</b>	☞ <i>The project does not encroach on any place of habitation.</i>	<b>H (P)</b>	Establishing the project will not require any population displacement.

**Legend:** W: Weak ..... A: Average ..... H: High ..... (N): Negative  
..... (P): Positive

## 6. POTENTIAL IMPACTS, MITIGATION AND REHABILITATIVE MEASURES

### 6.1 Negative Impacts during the Works Phase

Impact assessment is conducted on activities targeting the installation of the power plant, in particular civil engineering works: (i) site preparation; (ii) roads and platforms; (iii) trenches; (iv) foundations; (iv) system of cabling and mounting of PV modules, etc.

During the works phase, the following activities can generate environmental impacts:

- Freeing of the right-of-way of works (cleaning and clearing of the right of way, construction of access roads, etc.);
- Establishment of works site and living base;
- Movement and operation of construction machines and equipment (graders, compactors, trucks, concrete mixers, etc.);
- Earthworks as well as stripping, excavation and compacting works;
- Masonry works (use of labour);
- Exploitation of borrows and quarries; and
- Installation of equipment.

The components of the environment likely to be affected by the project and significantly by the activities (or sources of impact) are physical (soil, air, water), biological (vegetation), and human (people's economic activities, public health, employment and quality of life). The most significant negative impact is linked to loss of biological resources.

#### *Impacts on the Biological Environment*

The works site will be established following the clearing of the right-of-way. Although deforestation for project needs will contribute to the loss of plant diversity, the impact on plant resources following the clearing of the right of way will be relatively low. In fact, the related vegetation is very disparate with a low rate of renewal. Nevertheless, if appropriate development measures are not taken, it is feared that two species (*Ziziphus mauritiana* and *Acacia radiana*), classified as endangered in Senegal and partially protected in the Forestry Code, will be lost. Apart from the loss of on-site diversity, the opening of new quarries and sand borrow sites is likely to lead to the destruction of vegetation.

As far as sensitive zones are concerned, the project site does not intercept any of the classified forest (Keur Mbaye CF, Bokhol CF, Mbilor CF and Goumet CF) or sylvopastoral reserve, all located very far away. The project's implementation is not expected to have any impact on sensitive zones.

Due to the poor vegetation (isolated trees, *Leptadenia pyrotechnica* tufts, ground/tree gaps), the project area is not conducive for the development and maintenance of fauna. The loss of wildlife habitats during the clearing of the right of way should not be exaggerated since the core environmental conditions have shown a very poor faunal diversity.

The project does not intend to use borrow sites for construction. This will be avoided as much as possible given the effect on foliage. The felling of trees, in particular partially protected species, should also be avoided by adopting a development plan. In case of force majeure, felling tax should be paid to offset the loss of species.

### 6.2 Negative Impacts in Operation Phase

The most significant potential impacts are related to:

#### *Incidence on the biological environment*

No significant negative effect on plant diversity is to be feared during the operation phase, but spontaneous vegetation can develop beneath and/or between the panels. The first scenario considered is that vegetation does not grow beneath the panels: shading effect of the panels. Whatever the case, if

vegetation develops on the site, this can lead to the risk of herdsmen vandalizing the wire fences (security fence) to let animals through. At this time of the year, pasture resources generally become scarce within the project area.

During this phase, erecting a rigid protective fence can have an impact on the mobility of fauna. It can hamper the free movement of species, especially small mammals and reptiles. However, it should be emphasized that a PV power plant’s enclosure is normally an integral part of the insurer’s requirements.

Installing a surveillance projector could induce impacts on bird fauna and chiroptera. Due to the size of the site (50ha00a02ca) and the need to secure investments (panels and other equipment), this incidence can be significant especially since the area is home to much diversified bird fauna (Djoudj Park).

Water birds and shorebirds could mistake the solar cell modules for water surfaces due to reflection (modified luminous spectrums and polarisation) and attempt to land on them. In fact, the light of the sun is polarised by reflection on bright smooth surfaces (for example, the surface of water, wet roads). The polarisation plane depends on the position of the sun. Certain insects (such as bees, bumble bees, ants, a few flying aquatic insects) have the well-known ability to perceive polarised light in the sky and to be guided to it. Since light reflecting on modular surfaces might modify the polarisation planes of the reflected light, that can cause discomfort in certain insects and birds, which risk confusing them with aquatic surfaces.

These suspected impacts on fauna (water birds, insects, etc.) must be monitored.

It is also worth noting that operating a power plant can have an impact on the itinerary of livestock (transit zone).

**Incidence on services rendered by ecosystems**

The vegetation on the site comprises 570 feet of perennial timber, 37 of which belong to partially protected species as defined in the Forestry Code. Grass cover is virtually non-existent.

Despite weak diversity, the site fulfils different ecosystem services. The assessment of the services rendered by ecosystems is based on the importance that the local dwellers, for example those of Bokhol Commune, in general, and villages closest to the site (Ngambou Thille, Damlawaly), in particular, give to the developed components, including flora and vegetation.

According to the local population and forestry services, the site’s flora and vegetation render various services. Below is a summary of the services mentioned by the local people during the public consultation.

Categories of Services	Services
<b>Supply</b>	<p><b>Source of energy</b></p> <ul style="list-style-type: none"> <li>Gathering of dead wood or cow dung;</li> </ul> <p><b>Service and local economy</b></p> <ul style="list-style-type: none"> <li>Exploitation of forest products: <i>sidem</i> (<i>Ziziphus mauritiana</i>), <i>slop</i> (<i>Balanites aegyptiaca</i>), gum arabic (<i>Acacia radiana</i>), etc.</li> </ul> <p><b>Cattle feed</b></p> <ul style="list-style-type: none"> <li>Exploitation of tree fodder (<i>goniakidées</i>) ;</li> <li>Exploitation of grass fodder.</li> </ul>
<b>Cultural</b>	<p><b>Existence value of biodiversity:</b></p> <ul style="list-style-type: none"> <li>Partially and/or endangered species: plant materials (<i>Ziziphus mauritiana</i>, <i>Adansonia digitata</i>, <i>Acacia radiana</i>)</li> </ul>

The species perform different ecosystem services. For example, local service and economy, food for cattle, and existence value represent a small proportion of the flora and vegetation on the site. These include: *Balanites aegyptiaca* (100); *Leptadiana hastata* (25); *Adansonia digitata* (4); *Ziziphus mauritiana* (15); *Tamarindus indica* (4); and *Azadarachta indica* (2). Species with a high socio-economic value represent 26.31% of the site’s flora and vegetation.

In addition, the substrate (five (5) hectares) and vegetation are carbon sinks since they contribute to CO<sup>2</sup> regulation on the planet.

### **6.3 Positive Impacts**

The project will not affect anyone and will cause no prejudice since the hosting site is free from occupation. The land in question belongs to the Bokhol Commune and has been assigned to the Sponsor for a period of 25 years.

The implementation of the photovoltaic park project will bring about many positive socio-economic and environmental impacts, including:

→ **During the works phase**

- Contribution to local employment (drop in youth unemployment). The agreement between *Synergie 2* and the former rural community provides for the guarantee of the employment of locals at the rate of 40% for the population of surrounding villages and 60% for the population of the other villages;
- Increase in local purchases (the project's base camp) and the positive effects on the revenue of Senegalese sub-contracting enterprises;
- Transfer of know-how to private sector management cadre;
- Contribution to an increase in tax revenue (imports, transport, sub-contracting, etc.).

→ **During the operating phase**

√ **At national level**

- Reduction of the consumption rate of fossil fuels and contribution to the LPDSE goal of raising the internal rate of consumption of bio-fuels and renewable energies to at least 15% by 2020;
- Contribution to the diversification of energy sources: the expected power corresponds to 2.43% of the total power installed by SENELEC and IPPs, and 4.21% if we consider the installed production exclusively by SENELEC in 2012 ;
- The operation of the power plant at full capacity will allow for increasing service coverage and the access rate at the national level. An additional 190,000 people are expected to have access to electricity via the interconnected grid, which corresponds to about 1.36% of the national population;
- The power plant will be an addition to the SENELEC network, thus contributing to lowering load-shedding, raising the electricity rate and their economic and social effects;
- Reduction of greenhouse gas emissions;
- Increase in the State's financial resources (taxes);
- Economic profit for national sub-contractors;

- Transfer of expertise and technologies to national structures and engineers/technicians; etc.

√

**At local level**

- Positive impact on local taxation: the company will pay council taxes, in particular business licence tax. The agreement between *Synergie 2* and the erstwhile rural community provides for the establishment of the company headquarters in the commune, which will help to boost its tax receipts, subject to legal feasibility pursuant to the provisions of the General Tax Code;
- Development of land;
- Restoration of biodiversity and development of the agricultural potential: this positive impact will be obtained when the panels are inclined (in shed) and sufficiently spaced, so as to be compatible with plants that need a minimum of space and light to grow between and beneath the panels. The panels should also be raised at least 20 cm above ground level so that plants will not shade the solar cells. The distribution of the substrate, used to ballast the panels, is also very important. Eight (8) cm would suffice in front of the panels to maintain low vegetation while behind and beneath, the distance can be increased to 14 cm in order to foster the growth of partial shade plants. Therefore, the types of plants and grains chosen may differ, depending on the situation. Undesirable (semi-spontaneous, invasive or other) that can cast a shadow on the panels will be weeded out during monitoring visits;
- The opportunity for local communities to benefit from capacity-building and corporate social and environmental responsibility actions helping them to have better access to basic social services (drinking water, education, health, electricity, etc.), to increase their revenue and hence reduce poverty.

### 6.3 Mitigation and Rehabilitative Measures

#### During the works phase

– *Measures concerning biodiversity*

To mitigate impacts on biodiversity, the site development plan will be implemented in a manner as to avoid felling any partially protected tree species (*Ziziphus mauritiana* and *Acacia radiana*). In case of special constraint to avoid a shadowing effect, felling will be tolerated. The inventory conducted during the EIA in connection with forestry services will serve as a basis for the design of a clearing procedure before works start-up. In terms of compensation, reforestation actions will be carried out in the water and forestry sector, taking into consideration the priorities of the local population.

– *Land related measures*

The land allocated for the project is national land. The law on national land stipulates that: “The State shall hold all national land to ensure its rational use and development based on development plans and management programmes. National land may be registered only in the name of the State”. The analysis on services rendered by ecosystems shows risks of restriction of access to land, the consequence of which is loss of community assets. To restore these rights and beyond promoting socio-economic development actions for the affected communities, provisions are in place for a biodiversity compensation plan which will be refined and supplemented during the preparation of an abridged Compensation Action Plan as was recommended.

– *Measures concerning water resources and erosion control*

The developer will set up a procedure for preventing and treating accidental spills. In the works phase already, the project will set up an erosion control mattress to stabilise surface soil and establish a plant cover (consider the risk of fire by planning a firewall and shadowing effects).

– ***Measures concerning wastes***

The developer will prepare a solid/liquid waste management plan. Actions to manage wastes likely to be generated by the works site will be defined taking into account national regulations (Environment Code, order on management of used oil, decree on BAPU, etc.) and available local, regional and national infrastructure. Wastewater will be collected in mobile, leak-proof septic tanks and deposited in the Dagana STEP. Pre-treated wastewater can be re-used subsequently to water plants, if the recommendations of the enabling decree of the Sanitation Code are followed (*The egg content of nematoda which must be one viable egg/litre or less, in the case of unrestricted irrigation*).

– ***Safety and health measures***

Safety measures aim to protect workers and the local population as well as the zones crossed during the transportation of materials and equipment. A number of procedures will be established for loading/off-loading materials and equipment, storing fuel, installing and carrying personal protective equipment and extinguishers, recording incidents/accidents, fire permit, working within electricity risky zones, staff authorisation (authorization for staff undertaking electricity operations on installations or in the neighbourhood), etc. Furthermore, plans guiding movement and the posting of safety instructions on site (wearing of personal protective equipment, working in risky zones, etc.) as well as safety buoys will be established. An information plan will be prepared to sensitise workers and the population on safety measures. This plan will include a mechanism for handling complaints from staff and the population about safety and health issues. The information plan will also serve as a medium for sensitising workers and the local population on the most frequent pathologies in the zone and on STDs, particularly AIDS.

Also, the technical and legal compliance of special equipment (pressure appliances, lifting equipment, electrical installations and equipment, etc.) will be checked before procurement or use. Additionally, the builder will be asked to prepare: a special health safety and protection plan (PPSPS), a prevention tool allowing the main contractor or others present on the works site to assess the occupational risks linked to co-activity and to adapt operating methods in consequence; an evacuation plan, and to put in place an infirmary for first aid.

– ***Social Measures***

Social measures are partly based on the terms of the agreement between the developer and the commune. For skilled employment, preference will be given to the local population on equal competence. For unskilled jobs, the local populations will systematically be recruited. A recruitment plan will be discussed with the commune and validated by the Deputy Prefect (“Sous-Préfet”). This plan will specify the number of persons needed per work station, depending on the state of progress of works, possibly the required qualifications, the duration of employment, the conditions of remuneration, etc. Rehabilitation works will be handled by women of surrounding villages organised in EIG.

Social measures also concern reforestation, assistance to the local community in delineating a pasture zone, definition of livestock itineraries and access to water, installation of solar panels for surrounding villages and training of selected persons to be mobilized during the operation phase, etc. These measures will be specified and supplemented as needed during the revision of the agreement between the developer and the local community.

**During the operating phase**

To bolster positive impacts on the human environment, rehabilitation measures will mainly concern the following aspects incorporated in the community development plan: (i) support for the running of



basic social services (schools, health facilities, etc.); and (ii) support for the population's income-generating activities, in particular agriculture. As gender mainstreaming fosters the advancement of women, the developer will implement a gender strategy. Compensatory measures as well as measures for improving living standards and income-generation capacity that will be finally validated as part of the abridged Compensation Action Plan could be integrated in the community development plan.

As far as biodiversity is concerned, there are plans for: (i) ornithological monitoring to ensure that the project does not affect the bird fauna; and (ii) reforestation actions.

A wastes management plan will be prepared by the developer to cater to hazardous wastes likely to be produced on the site, namely used oils and waste electrical and electronic equipment (WEEE). A WEEE prevention policy will be implemented in the choice of equipment. Furthermore, in choosing suppliers, account will be taken of their belonging to sectors with extended producer responsibility (EPR) since there is no technical infrastructure for waste treatment and/or recycling in the country. WEEEs cannot be avoided and/or re-exported to the producers. So, their final storage (waste confinement) will be done pursuant to the French Order of 1 July 2013 on the storage of scrapped electrical and electronic equipment.

#### **6.4 Residual Impacts**

The residual impacts stemming from works and operation are at an acceptable level, in light of the regulations and environmental and social concerns.

## **7. ENVIRONMENTAL RISK MANAGEMENT AND CLIMATE CHANGE**

### **7.1 Project-Related Environmental Risks**

The project-related environmental risks are low in both the works and operation phases. These risks relate to the generation of hazardous wastes, including used oil and toxic wastes in dispersed quantities (TWDQ). These wastes are managed pursuant to the regulations in force. They will be handed over to authorised collectors with a requirement of traceability accompanied by hazardous wastes tracking documents (BSDD).

The storage of WEEEs will entail no environmental risk. Risks related to air pollution concern accidental events (fire) and are addressed in the storage rules. In designing the storage facilities, due regard should be given to their resistance to fire, appropriate ventilation and containment. Storage facilities will have the following minimal characteristics in terms of reaction to fire: Class A1 materials according to NF EN 13 501-1 (non-combustible).

The risks of water and soil pollution are associated with the use of fire-extinguishing water. These risks will be treated in the operator's internal operations plan.

### **7.2 Climate Change**

The Second National Communication on Climate Change provided a platform for drawing up a national inventory on GHG emissions, using a sector-based approach<sup>1</sup>. The energy data contained in Senegal's Energy Information System (EIS) report were used in this communication to calculate GHG emissions in the energy sector. The inventory methodology used was developed by the Intergovernmental Panel on Climate Change (IPCC, revised version of 1996). It is based on:

- Estimate of the apparent fuel consumption, expressed as a unit of origin;
- Conversion into a common energy unit;
- Multiplication by emission factors to calculate the carbon content;
- Computation of stored carbon;

<sup>1</sup> The Third Communication is in the process of validation

- Correction to take into account the incomplete combustible;
- Conversion of oxidised carbon into CO<sup>2</sup>;
- Emissions due to non-imported finished petroleum products are accounted for under emissions due to crude oil, given the estimation method used, to avoid double entry; and
- Emissions due to imported refined petroleum products are entered into the accounts.

The results of the Second National Communication show that for total emissions of 6,481 (Gg ECO<sub>2</sub>), the “residential” and “charcoal production” sub-sectors account for the largest share with 23.3% and 20.89%, respectively. These emissions come from domestic uses of firewood and charcoal for home use and the transformation/carbonisation of firewood. *The electricity-production sub-sector contributes up to 14.9% of total emissions.*

#### → Calculation of project emissions

During this environmental and social assessment, no methodology specified the level of consideration of the mitigation dimension since the intention was not to develop an MDP project. It is worth noting that no standard baseline (SB) is defined in Senegal for the electricity sub-sector. The SB helps to calculate a baseline once for the industrial sector instead of having a separate calculation for each MDP project. Once an SB is approved, it can be applied to other similar projects.

This assessment uses by default the methodology applied by the European Bank for Reconstruction and Development and relies on PDD-related data available on the UNFCCC website and, among other methods, on the data of the International Energy Agency for other countries not having registered projects.

$$EF_{\text{grid reduced}} = EF_{\text{grid,produced}} / 1 - \text{losses}$$

- "**EF<sub>grid,produced</sub>**" = EF (emission factor) grid, produced: Used in calculating emissions for projects providing supplementary electricity to the grid (tCO<sub>2</sub> / MWh);
- "**EF<sub>grid reduced</sub>**" = EF (emission factor) grid, reduced : Used for projects to reduce grid electricity consumption (tCO<sub>2</sub> / MWh);
- "**losses**": Network losses for each country calculated based on data culled from IEA data updated in 2006.

An emission factor in Senegal’s inter-connected grid (**EF<sub>grid reduced</sub>**), according to available data, of **0.637 TCO<sub>2</sub>/MWh** was used.

To determine CO<sub>2</sub> emissions avoided each year, it is necessary to move from production capacity to energy quantity, considering a load factor estimated at 20%.

Thus, the quantity of CO<sub>2</sub> emissions avoided = 0.637 TCO<sub>2</sub>/MWh x 20 MW x 8760h x 0.2 = 22,320.48 TCO<sub>2</sub>/yr., or 22.3 GgCO<sub>2</sub>/yr.

## 8. ENVIRONMENTAL AND SOCIAL MONITORING PROGRAMME

An environmental monitoring programme will be prepared to ensure the proper implementation of works during the pre-construction and construction phases, and the proper operation of equipment and installations during the operating phase. The programme aims principally at ensuring compliance with

the following elements: relevant laws and regulations; conditions set by regulatory authorities; and developer's commitment to authorisations and measures proposed in the environmental impact assessment, especially mitigation measures.

### ***SURVEILLANCE PRINCIPLES***

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Environmental surveillance should be understood as all inspection, supervision and intervention activities aimed at verifying that:

- All requirements and conditions for environmental protection are effectively respected before, during and after works;
- Environmental protection measures prescribed or planned are implemented and help to achieve the set objectives;
- Risks and uncertainties can be managed and corrected in a timely manner.

Environmental surveillance is mainly concerned with adhering to environmental protection measures recommended as part of this environmental impact assessment. Surveillance allows for controlling their effectiveness and efficiency.

The publication of a surveillance report is an integral part of environmental surveillance activities.

### ***IMPLEMENTATION OF ENVIRONMENTAL SURVEILLANCE***

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The developer undertakes to carry through a detailed environmental surveillance programme with the following phases: (i) pre-construction, pre-development; (ii) construction, development; and (iii) dismantling. The requirements of the surveillance plan are as follows:

- Compliance of works, materials used and operations with the standards and regulations in force, and with other applicable requirements;
- Special attention to limit alterations of the biophysical components of the environment (soil, water and vegetation), and the construction (roads, foundation);
- Optimised planning to limit the works periods and the impacts on the environment and quality of life of local residents ;
- Compliance of all contractors and sub-contractors on the ground with HSE requirements;
- Minimised risk of accidents through precise identification of working areas, including signage when deemed necessary; and
- Adequate management of ordinary wastes and hazardous wastes.

#### ✓ **Pre-Construction Phase**

The first stage in environmental surveillance is to put in place the Health, Safety and Environment (HSE) function within the developer's team and require same for the construction firm. A schedule of environmental surveillance missions should be prepared and aligned with the works implementation schedule.

#### ✓ **Construction Phase**

When development activities start, daily surveillance is undertaken by members of the HSE team to ensure compliance with the conditions linked to authorisations, especially mitigation measures. An agreement will be defined to ensure environmental surveillance.

#### ✓ **Post-Development Phase**

At the end of construction activities, the HSE team will ensure the proper rehabilitation of the right-of-way and temporary working areas. Photographs will be taken along the right-of-way particularly during the period of restoration of the work zone. Furthermore, throughout exploitation, the developer is expected to plan regular inspections involving the detection of modifications of the surrounding environment.

The developer can call in external resource persons or specialised firms.

### ✓ **Dismantling Phase**

Upon final cessation of the operating phase, the developer will dismantle the works while respecting standard rules and avoiding any soil contamination. At this level, environmental surveillance will relate to the verification of conditions of removal of equipment and demolition of buildings, and their elimination in line with the regulations and good practice.

### **Environmental Monitoring Programme**

Environmental monitoring refers to observation activities and measures aimed at determining the real impact of an installation relative to the predicted impacts in the EIA. It also serves to detect unexpected impacts and to verify uncertain outcomes. The environmental monitoring programme is presented in the following table. Measures to be implemented will be compared to a baseline situation to be determined before works or operation, as the case may be. Certain measures can be abandoned if it is demonstrated that they have no real impact.

### **Environmental Monitoring Plan**

<b>Component</b>	<b>Measure</b>	<b>Period</b>	<b>Frequency</b>	<b>Indicator</b>	<b>Annual Cost (CFAF)</b>
Physical environment (landscape)	Carry out photomontages	Ongoing	3 months		1 200 000
Biological (water birds, insects, reptiles and rodents)	- Monitoring of water birds - Monitoring of insects - Monitoring of reptiles and rodents (training of security staff to capture snakes, provision of suitable antidotes on CAP recommendation and use of approved pesticides) - Monitoring of grain-eating birds	To be defined for the national parks	To be defined for the national parks		
Biological (plant cover)	Monitoring of the survival rate	Over three years	3 months	Number of inventory missions	1 000 000
Security	POI tests and exercises	Ongoing	Tests (half-yearly) Exercises (variable)		3 000 000
Human environment (noise)	Measurement of surrounding noise and hygiene	During works	Depending on works schedule		
Human environment (social)	Monitoring/evaluation of social measures	During operating phase	Annual	Number of monitoring/evaluation reports	2 000 000

### **Institutional Arrangement for Monitoring ESMP Implementation**

The developer will be responsible for the environmental and social management of the project, pursuant to the regulations in force. The commitments of the ESMP should be reflected in the contract binding the developer and the private operator, and will be monitored by the latter using internal resources or a consultant.

An institutional arrangement (agreement) is recommended between the developer and DEEC to lay down practical modalities related to environmental monitoring actions that fall within the province of the technical capacity-building committee. The related costs will be borne by the developer pursuant to

the regulations in force, which assign to it the cost of the impact assessment procedure. It is recommended that two environmental monitoring missions be fielded per year on the site.

At regional level, the relevant technical service will assume a control role in environmental monitoring for each impact mitigation, environmental surveillance and/or environmental monitoring action. If need be, these services could call in technical resources from the central level. Environmental monitoring reports will be systematically forwarded by the competent services to DREEC/DEEC.

The developer is expected to submit annual ESMP implementation reports that will be validated by DEEC, after an inspection visit by the technical committee.

### ESMP Implementation Schedule

The ESMP will be implemented as per the schedule presented below and in conjunction with the project's technical/economic planning.

Provisional Date	Technical Measure	Environmental Measure	Responsibility for Implementation	Responsibility for External Monitoring	Responsibility for Internal Monitoring
November 2015 - December 2015	Finalisation of technical design and integration of ESMP measures	<ul style="list-style-type: none"> <li>- Implementation of an abridged Compensation Action Plan procedure</li> <li>- Implementation of social measures before works (recruitment of staff, pasture zone, etc.)</li> </ul>	Operator	SYNERGIE2	Technical Committee
January 2016 - June 2016	<ul style="list-style-type: none"> <li>- Site preparation</li> <li>- Construction works</li> <li>- Tests</li> <li>- Acceptance</li> </ul>	<ul style="list-style-type: none"> <li>- Implementation of actions defined in the mitigation plan and surveillance plan (works phase)</li> <li>- Implementation of capacity-building plan</li> <li>- Implementation of Environmentally Protected Facility (ICPE) authorisation procedure</li> <li>- Implementation of social measures (training and recruitment of staff for the operations phase, establishment of a social community development plan)</li> </ul>	Operator (mitigation measures and ICPE authorisation)  SYNERGIE (environmental surveillance and capacity-building, social measures)	SYNERGIE2	Technical Committee
June 2016 - June 2036	Operation of the power plant	<ul style="list-style-type: none"> <li>- Implementation of actions defined in the surveillance plan, technological risk management plan (operation phase)</li> <li>- Regulatory monitoring</li> <li>- Environmental audit (annual) and ESMP update</li> <li>- Implementation of the social community development plan</li> <li>- Design of a detailed plan for closing the site and dismantling installations</li> </ul>	Operator (mitigation measures, regulatory monitoring and ESMP update) SYNERGIE (environmental surveillance, social measures)	SYNERGIE2	Technical Committee
July 2036 <sup>2</sup>	Dismantling of installations		Operator (design and implementation of the plan)	SYNERGIE2	Technical Committee

<sup>2</sup> The duration of the contract with SENELEC is 20 years, which can be extended based on potential additional clauses

**ESMP Cost**

The total ESMP cost of CFAF 571,166,000 is broken down as follows:

<b>ACTIVITIES</b>	<b>COST</b>
Mitigation plan during the start-up phase	89,500,000
Mitigation plan during the operating phase	38,500,000
Environmental monitoring plan	7,200,000
Capacity-building plan	29,300,000
Felling	4,666,000
Provisions for implementation of compensation and improvement measures	350,000,000
Physical contingencies (10%)	52,000,000
<b>TOTAL</b>	<b>571,166,000</b>

## **9. PUBLIC CONSULTATIONS AND INFORMATION DISSEMINATION**

The ESIA was conducted using a participatory approach initiated at the upstream stage of the project at the time of validation of its terms of reference by the groups concerned.

The ESIA stems from information obtained from background documents, digitised topographic maps and inspection visits as well as from interviews with representatives of various technical services of the relevant ministries, NGOs, private operators, socio-professional groups, the neighbouring population, local authorities, village heads and leaders of thought. Prior to each meeting, the project's contents were presented to the group consulted in terms of the economic, social, cultural and environmental stakes as well as mitigation and improvement measures.

At the end of the consultations, the acceptance of this photovoltaic solar power plant project in Bokhol commune was clearly and explicitly manifest. The following table summarises the key elements to be retained:



<b>Reactions</b> <b>Actors</b>	<b>Perceptions and Concerns</b>	<b>Expectations and Recommendations</b>
<b>Directorate of Taxes and Land Tenure</b>	- Land registration and related legal aspects	- Compliance with the lease application procedure
<b>Directorate of Cadastral Survey</b>	- Allocation of the land	- Verify whether the land is not in dispute between the Bokhol and Gaya councils
<b>Directorate of Livestock</b>	- Risk of cutting off the pasture land from the cattle zone - Risks of accidents with herds in the zone - Loss of pasture land for livestock farmers of the zone	- Lay out cattle pasture land in the permit area of the plant
<b>Directorate of Water Resources</b>	- Avoid polluting the zone's rare water tables - Avoid obstructing access to temporary ponds and water bodies	- Ensure rational use of water resources in the power plant's activities - Drill a standalone borehole outside the existing water supply arrangement to the population - Do not use chemicals in plant operations
<b>Directorate of Labour</b>	- Working conditions - Health - Hygiene - Safety	- Respect labour legislation - Propose to employees due contracts signed by the departmental inspectorate - Establish mechanisms for protecting workers' health and safety
<b>Directorate of Water and Forestry</b>	- Modification of the ecosystem and disturbance of the environment - Substantial loss in the project area - Risk of disappearance of certain species in the zone	- Maintain the balance of the ecosystem - During works, request the intervention of technical services having project-related expertise - Carry out reforestation operations
<b>Saint-Louis Regional Fire-Fighting Brigade</b>	- Safety - Manifestation of lightning	- Respect safety and security standards - Install lightning conductors
<b>Saint-Louis Regional Agency of SENELEC</b>	- Bokhol Photovoltaic Power Plant	- This is a good project that will help to strengthen the SENELEC electricity supply network
<b>Dagana Prefecture</b>	- Bokhol Photovoltaic Power Plant	- The project is very important for the zone considering that some villages are not yet electrified
<b>Council Office</b>	- Delighted with the idea that such a project is being established in the locality.	- Honouring of commitments taken by the developer vis-à-vis municipal authorities and the population - If possible, plan training sessions for the population to enable them to have the required skills to work in the power plant - Water and electricity supply - Undertake a reforestation campaign - Undertake sensitisation campaigns on safeguarding the environment, targeting the population
<b>Village notables</b>	- Pollution and nuisances	- Prioritise youth of the locality during recruitments - Aid the Muslim community to complete the mosque and a Franco-Arabic school - Help the community to construct basic infrastructure (health post; school, sports pitch) - Honour commitments
<b>Population</b>	- Delighted that such a project is being established in Bokhol - Non-compliance with environmental standards and commitments taken towards the populations	- Prioritise youth of the locality during recruitment - Insist on compliance with environmental and safety standards - Control deforestation - Prioritise youth of the locality in recruitment - Social works

During project implementation, all partners will be regularly consulted through the public press and during village meetings.

Further, the summary of ESIA/ESMP will be published on the Synergy2 website and that of the Bank.

## 10. COMPLEMENTARY INITIATIVES

### Rent Payment

The agreement signed between *Synergy2* and Bokhol Commune provides that in exchange for land allocated, *Synergy2* shall pay annual rent of CFAF 8,000,000. The duration of this agreement spans 25 years. This amount will be integrated in the Commune's revenues; which will enable the latter to finance municipal investments.

### Payment of an Annual Allocation to Bokhol Commune

Under the agreement signed between *Synergy2* and Bokhol Commune, it is stated that *Synergy2* undertakes to pay annually the sum of CFAF 8,000,000 which will serve to finance actions contributing to the improvement of the living conditions of the Bokhol population. The duration of this agreement spans 25 years. The agreement may be updated continually to reflect the priority development thrusts of the locality and adjustments to be made with due regard to inflation and the synergy to be forged with other public and private stakeholders operating in the zone.

### Aid to Rural Electrification

In the agreement between *Synergy2* and Bokhol Commune, *Synergy2* undertakes to contribute to rural electrification in the project's direct target area (installation of street lighting, provision of solar kits, etc.) to the tune of CFAF 35,000,000. Beside the Council Office, *Synergy2* will also negotiate with SENELEC and the Ministry of Energy to promote a general operation to electrify the zone. This aid to rural electricity fits into a comprehensive community development support plan aimed at restoring a number of losses linked to services rendered by ecosystems, improving people's standard of living and their income-generating capacity.

## 11. CONCLUSION

Energy is one of the most decisive factors of production in economic growth. Increasing installed power will enable Senegal to reduce the electricity tariff and have a more competitive economy. It will also facilitate social inclusion by fostering more democratic access to electricity.

The project to set up a 20 MW photovoltaic solar power plant in Bokhol Commune is an appropriate response to Senegal's orientations in the energy sector, materialised by the strategic energy-mix option, one of the major stakes of the Emerging Senegal Plan (PSE). Recourse to renewable energies, in particular solar PV through the project, is a meaningful option to mitigate fluctuating world market prices of oil, improve the country's energy security and facilitate the removal of budget-absorbing industrial installations that upset the financial balance of the sub-sector.

Apart from these technical/economic considerations, the project's environmental and social feasibility is relatively high. In fact, it contributes to achieving the objectives concerning the intended nationally determined contributions (INDC) which Senegal undertook to respect during implementation of the UNFCCC mitigation dimension and in prelude to the 2015 Paris Summit which aims to obtain an agreement limiting the rise in global temperature to 2°C. Unlike conventional energies, solar PV has no atmospheric emissions that negatively affect the health of the population.

The negative effects of this kind of project are more to do with loss of land and biodiversity. However, such losses are limited in the case of the Bokhol project. The analysis of the baseline situation shows advancing desertification and a scarcity of water resources, which have gradually led to land degradation and a net decline in agricultural activity and the plant cover. Nevertheless, it is worth noting that this process can still be reversed under certain conditions; hence the importance to take charge of these underlying issues in the compensation mechanisms.

It is also important to stress that establishing an industry in the area will be perceived as an

opportunity to facilitate technical and financial support to the community, in particular women, and to revive agricultural activities via local taxation and capacity-building actions as part of compensation and social responsibility. The project will consequently help to restore biodiversity and develop agriculture.

Additionally, at the social level, the project will boost local employment during the works and operation phases through the implementation of an inclusive recruitment policy.

These positive effects will become manifest if environmental surveillance actions are properly implemented. Beyond that, implementing resolute policies in terms of organisation and commitment, in particular corporate social responsibility (CSR), will help to get there.

Residual technological risks linked to the operation can be significant, hence the mitigation actions proposed. It is also important to stress the need to strengthen the fire-fighting brigade's capacity to intervene in case of fire.

## 12. REFERENCES AND CONTACTS

### REFERENCE DOCUMENTS

- ESIA Report Volume 1 of the Project to Establish a 20 MW Photovoltaic Solar Plant in Bokhol Commune. Conducted by *BEIEEC Environnement Sarl*, in collaboration with *GERTECS Sarl*
- ESIA Report, Volume 2 "Study of Danger". Project to Establish a 20 MW Photovoltaic Power Plant in Bokhol Commune. Conducted by *BEIEEC Environnement Sarl*, in collaboration with *GERTECS Sarl*

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## ANNEX

### MATRIX OF ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

#### Mitigation Plan during the Start-up Phase

#### → Hygiene - Environment - Social Plan

Potential Outcomes/ Impacts	Mitigation Measures	Cost (CFAF) <sup>3</sup>	Maturity	Indicator	Source of Verification	Responsibility		Monitoring Site
						Implementation	Monitoring	
<b>Biological Environment</b>								
Loss of plant diversity	Preserve special status species that do not hamper project activities	2,500,000	Before publication of BD for construction	Number of standing special status species preserved	Visual inspection Plan to develop the plant diversity of the site BD	SYNERGIE2	IREF/Technical Committee	Works site
	Undertake compensatory reforestation	CFAF 200,000/ha	End of works before operation	Number of trees planted	Works acceptance report	SYNERGIE2	IREF/Technical Committee	Reforestation site
				Area replanted with trees	Visual inspection			
Sampling of materials in authorised borrow sites			During works	Quantity of materials taken without authorisation	Administrative clauses of BD - Monitoring of works site and felling tax counterfoils	SYNERGIE2	Mining Department/ Technical Committee	Borrow sites
<b>Impacts on the Physical Environment</b>								
Pollution of pedological resources	Provide for retentions in accordance with standards at the level of oil and gas storage	500,000	Before operation	Number of compliant retentions installed	Visual inspection	SYNERGIE2	DREEC/ Technical Committee	Site base
Degradation of air quality	Sprinkle the works site with water to reduce airborne dust	Cost of drinking water in the zone	During works	Number of sprinklings per day	Visual inspection	Builder	DREEC/ Technical Committee	Project site
	Use canopy trucks to transport pulverulent materials (sand, rice grains, etc.)	Cost included in the bid of the works contractor	During works	Number of canopy trucks/ Number of supply trucks	Visual inspection	Builder	DREEC/ Technical Committee	Works site entrance
Pollution of water resources	Establish a runoff drainage plan	Cost included in bidding document	During works	Effectiveness of drainage plan	Visual inspection and plan	Builder	DREEC/ Technical committee	Works site
	Establish a waste water management plan (collect waste water in leak-proof septic tanks, hand over the waste water and mud to an authorized service provider	-	During works	Effectiveness of the procedure	Forwarding slip	Builder	DREEC/ Technical Committee	Base camp

<sup>3</sup> Cost of study, investment and operation during the duration of works

Potential Outcomes/ Impacts	Mitigation Measures	Cost (CFAF) <sup>3</sup>	Maturity	Indicator	Source of Verification	Responsibility		Monitoring Site
						Implementat-ion	Monitoring	
	and unpack them at the Dagana STEP)							
Noise pollution	Envisage a vehicle and machine maintenance programme and procedure for decommissioning polluting and noisy equipment		Before works	Effectiveness of the programme to monitor polluting and noisy equipment	Existence of the programme	SYNERGIE2	DREEC/ Technical Committee	
Wind erosion	Put in place an erosion control mattress and plant cover	7,000,000	During works	Length of established erosion control net Surface of plant cover	Visual inspection	SYNERGIE2I	IREF/Technical Committee	Surrounding environment
Impacts on the landscape	Prepare a development plan integrated in the landscape	4,000,000	Before building permit	Effectiveness of development plan validated by the town planning services	Existence of development plan	SYNERGIE2	Town planning	Works site
<b>Human environment</b>								
Loss of economic assets	Inventory PAPs, socio-economic analysis and compensation of rightful claimants		Before works	Compensations paid before works/Compensation evaluated	Report of maintenance expenditure assessment commission	SYNERGIE2	Lands Service/Technical Committee	Commune
Improvement of socio-economic impacts	Recruit local staff		Before works	Number of recruitments/ Number planned	Recruitment plan monitoring report	SENERGY II	Prefecture	Commune
	Identify and train staff for the operating phase	4,000,000	Before works	Number of persons trained/ Number of positions accessible	Recruitment plan monitoring report	SENERGY II	Prefecture	Commune
	Pasture area, grazing land and watering of cattle	15,000,000	Before works		Audit of ESMP	SYNERGIE2	Regional livestock department/ Technical Committee	Commune

### Mitigation Plan during the Start-up Phase

#### → Health-Safety Plan

Potential Outcomes/ Impacts	Preventive/ Protective Measures	Cost (CFAF) <sup>4</sup>	Maturity	Indicator	Source of Verification	Responsibility		Monitoring Site
						Implementat-ion	Monitoring	
<b>Human Environment</b>								
Outcomes on workers' and populations' health and safety	Put in place and apply health-safety procedures (loading/offloading of materials, equipment, offloading of fuel, installation and carriage of EPI and fire extinguishers, recording of incidents/accidents, fire permit, works in electrical risk zones,	5,000,000	Before works	- Number of procedures validated - Level of compliance	- Contractor's implementation file - Audit of ESMP	Builder	Regional civil protection commission/Tec hncial committee	

<sup>4</sup> Cost of study, investment and operation for the duration of works

Potential Outcomes/ Impacts	Preventive/ Protective Measures	Cost (CFAF) <sup>4</sup>	Maturity	Indicator	Source of Verification	Responsibility		Monitoring Site
						Implementation	Monitoring	
	authorization of staff, etc.)							
	Prepare and implement a traffic plan	1,000,000	Before works	Effectiveness of compliant and validated traffic plan	ESMP internal audit report	Builder	Regional Civil Protection Committee/ Technical Committee	Project site
	Post safety instructions on the site (wearing of EPI, risky work areas, etc.), safety buoys	2,500,000	Before works	Number of postings and compliant buoys	Visual inspection	Builder	Regional Civil Protection Committee/ Technical Committee	
	Implement a special plan for safety and health protection, and train staff (PPSPS)	3,500,000	Before works	PPSPS prepared Number of workers trained on PPSPS	ESMP internal audit report	Builder	Regional Civil Protection Committee/ Technical Committee	
	Prepare a site evacuation plan	1,500,000	Before works	Site evacuation plan prepared and validated by the Fire-Fighting Brigade	Existence of the plan ESMP internal audit report	Builder	Regional Civil Protection Committee/ Technical Committee	
	Put in place an infirmary	7,000,000	Before works	Infirmary functional (certified nurse, medications, first aid kit, drugs reserve, etc.)	- Contractor's construction records - ESMP audit	Builder	Regional Civil Protection Committee/ Technical Committee	
	Sensitise staff and the population on works site-related risks	3,000,000	Before and during works	Number of sessions organised Number of workers and people sensitised	Meeting reports	Builder	Regional Civil Protection Committee/ Technical Committee	

### Mitigation Plan during the Operation Phase

#### → Hygiene - Environment - Social

Potential Outcomes/Impacts	Mitigation Measures	Annual Cost (CFAF)	Indicator	Source of Verification	Responsibility		Monitoring Site
					Implementation	Monitoring	
<b>Biological Environment</b>							
Incidence on biological resources	Undertake the maintenance of reforested areas	3,000,000	Survival rate	Detailed inventory report	SENERGY II	IREF/Technical Committee	Reforestation site
<b>Physical Environment</b>							
Effects on soils, ground water and erosion	Implement the ordinary and hazardous wastes management plan	3,000,000	Level of compliance	ESMP internal audit	SENERGY II	DREEC/Technical Committee	Waste storage area
	Maintain plant cover and fire wall	7,000,000	Surface of plant cover	ESMP internal audit	SENERGY II	IREF/ Technical Committee	Surrounding environment
	Drain rain water	2,500,000	Level of water erosion (visual inspection)	ESMP internal audit	SENERGY II	IREF/ Technical Committee	Production site
<b>Human Environment</b>							
Improvement of socio-economic outcomes and community development	Implement the revised agreement	PM	Achievement rate of global indicators	Annual evaluation report	Local committee	Deputy Prefect (Sous-Prefet)	Commune
Economic displacement of the population	Design, implement and monitor an abridged resettlement plan	PM	Abridged resettlement plan validated by DEEC and AfDB	DEIE/DEEC Archives, Public Information Centre (AfDB)	SENERGY II	DEEC/ Technical Committee	Sub Prefecture



**Mitigation Plan during the Operation Phase**

→ **Health-Safety**

Potential Outcomes/ Impacts	Mitigation Measures	Cost (CFAF)	Indicator	Source of Verification	Responsibility		Monitoring Site	
					Implementation	Monitoring		
<b>Human Environment</b>								
<b>Procedures and Plans</b>								
Outcomes on workers' and people's health and safety	Establish and implement SST procedures	10,000,000	Procedures validated	Documentation system	Operator	Regional Civil Protection Committee/ Technical Committee		
	Implement a traffic plan	2,000,000	- Traffic plan prepared - Level of compliance	Documentation system	Operator	Regional Civil Protection Committee/ Technical Committee		
	Implement risk assessment procedures	2,000,000	- Procedure realised - Level of compliance	Documentation system	Operator	Regional Civil Protection Committee/ Technical Committee		
	Elaborate safety instructions	3,000,000	- Safety instructions prepared and validated - Level of compliance	Visual inspection (dangerous zones, risky equipment)	Operator	Regional Civil Protection Committee/ Technical Committee	- Dangerous zones, - Risky equipment	
	<b>Danger Communication, Staff Training and Authorisation</b>							
	Establish a plan to train and sensitise operators, sub-contractors ('Site Induction' and 'Tool Box Talk') and the local population	5,000,000	- Training plan designed - Number of training sessions conducted/year - Number of people trained	Training reports	Operator	Regional Civil Protection Committee/ Technical Committee		
	Train staff on life-saving actions (at least one employee in each risk workshop)	3,000,000/year	Number of staff trained/risky workshops	Training reports	Operator	Regional Civil Protection Committee/ Technical Committee		
	Post machine safety instructions		Number of safety instructions posted/Number of postings envisaged	Photographs	Operator	Regional Civil Protection Committee/ Technical Committee	- Dangerous zones, - Risky equipment	
	Post the traffic plan		Traffic plan posted at the level of the envisaged sites	Photographs	Operator	Regional Civil Protection Committee/ Technical Committee	Product ion site	
	<b>Prevention of Machine Risks</b>							
Design and implement a maintenance plan		- Maintenance plan designed - Number of major occurrence of non-compliance	Maintenance register	Operator	Regional Civil Protection Committee/ Technical Committee			
Undertake periodic inspections and verifications of installations and		- Number of inspections and verifications undertaken/	Technical verifications register	Operator	Regional Civil Protection Committee/			

Potential Outcomes/ Impacts	Mitigation Measures	Cost (CFAF)	Indicator	Source of Verification	Responsibility		Monitoring Site
					Implementation	Monitoring	
	equipment by approved bodies		Statutory number - Number of major occurrence of non-compliance			Technical Committee	
<b>Individual and Collective Protection</b>							
	Ensure supply and require the wearing of personal protective equipment (PPE)		- Number of compliant PPE - Level of compliance on wearing PPE	- PPE control form - Report on compliance of individual protection	Operator	Regional Civil Protection Committee/ Technical Committee	Production site
	Staff clearance		Number of clearance issued/ Number of compulsory clearance	Security assessment report	Operator	Regional Civil Protection Committee/ Technical Committee	Production site
	Install a lightning conductor and arrester		Certified lightning conductor and arrester installed	- Certificate of compliance - Acceptance report	Operator	Regional Civil Protection Committee/ Technical Committee	
	Put in place emergency equipment (fire extinguishers and wall hydrant) pursuant to APSAD <sup>5</sup> rules		Number of equipment installed pursuant to APSAD rules	- Certificate of compliance - Evidence of periodic verifications	Operator	Regional Civil Protection Committee/ Technical Committee	Installation plan of collective protection equipment
	Design an emergency plan (POI)						
<b>Site Security</b>							
	Put in place guard service and ongoing electronic surveillance		Availability of security system	Technical verification report	Operator	Regional Civil Protection Committee/ Technical Committee	
	Ensure the physical security of the site (wire fencing, spotlights)		Integrity of the system of physical on-site security	Technical verification report	Operator	Regional Civil Protection Committee/ Technical Committee	
<b>Occupational Medicine</b>							
	Set up an occupational medicine service, allocate evacuation resources and contract with health structures		- Number of pre-employment medical exams /Number of jobs - Number of statutory clinical exams per year per worker - Number of days of presence of occupational doctor/yr. - Availability of evacuation resources - Contracts with health structures	Assessment report of the general situation of hygiene and security in the establishment	Operator	Regional Civil Protection Committee/ Technical Committee	

<sup>5</sup> Plenary assembly of insurance companies

Potential Outcomes/ Impacts	Mitigation Measures	Cost (CFAF)	Indicator	Source of Verification	Responsibility		Monitoring Site
					Implementation	Monitoring	
<b>Organisation of Workplace Health and Safety (WPHS)</b>							
	Put in place a Health, Safety and Environment (HSE) service		Operator's organisational chart	<ul style="list-style-type: none"> <li>- Monthly HSE reports</li> <li>- Annual HSE reports</li> </ul>	Operator	Regional Civil Protection Committee/ Technical Committee	
	Put in place a WPHD/Safety Committee		HSE Procedures	<ul style="list-style-type: none"> <li>- Annual reports</li> </ul>	Operator	Regional Civil Protection Committee/ Technical Committee	
	Administrative declarations to the labour inspectorate (assessment report on the general situation of hygiene and security in the establishment, the opening of the occupational medicine service, cases of occupational diseases not featuring on the list of occupational diseases subject to compensation, staff trained in first aid, etc.)		Number of declarations per year	Register of security declarations	Operator	Regional Civil Protection Committee/ Technical Committee	