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PPP Mainstreaming – Solar Park

Energy Department, Government of Karnataka

Pre-Feasibility Report (Draft for discussion & finalization)

Submitted By
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1 Executive Summary

The National Action plan for Climate Change (NAPCC) has identified solar energy development as a thrust area for enhancing energy security and combating climate change and mandated the launch of the Jawaharlal Nehru National Solar Mission (JNNSM) to significantly increase the share of solar energy in the total energy mix.

Keeping in mind the long term benefits of promotion of solar energy, the Government of Karnataka has issued a separate policy named “Solar Policy 2011-16”. The Karnataka Renewable Energy Development Limited (KREDL), has been appointed as the nodal agency for facilitating & implementation of the Solar Policy. The KREDL is mandated to prepare the bidding documents, such as Expression of Interest (EoI), shortlisting criteria for Agencies, Request For Proposal (RFP), details of technical and financial aspects in the proposals, general/special conditions of contract. The Energy Department, Government of Karnataka through KREDL intends to develop Solar Parks in the State in order to encourage installation of the solar power projects for electricity generation. To facilitate the process, Govt. of Karnataka will identify the areas all across the State for setting up the Solar Parks. The Government of Karnataka has already identified area in Village- Mannur, Taluka- Basavana Bagewadi, District- Bijapur, for setting up the solar park.

This Pre-Feasibility Report (PFR) provides an overview on the requisites for the development of a Solar Park in Karnataka along with possible next steps for the government to consider. The Feasibility Study includes: a description of the Solar Park concept; a presentation of the proposed location of the Karnataka Solar Park and of the Park organization; an overview of the cost outlay & funding requirement for the Solar Park; key benefits and an operating framework indicate the possible model that may be adopted to set-up Solar Park.

The overall objective of setting up the Solar Park in the district of Bijapur in the State of Karnataka is to promote the development of the solar power projects for electricity generation. The overall aim is to install a capacity of around 500 MW in the solar park. This can comprise of both Solar PV as well as Solar Thermal projects. The 500 MW solar park is expected to attract an investment of around Rs 5300 Crores.

Preliminary estimates of the overall cost of infrastructure development indicate a total cost in excess of 340 crores for the 500 MW Solar Park in Village Mannuar. The infrastructure development at the solar park site will include land development, providing power evacuation facility, water supply network and access roads.

The Solar park is expected to house a number of projects. It is proposed that one or more blocks of land identified in the solar park will be allocated to different project developers in order to have a concentrated zone for solar development. Individual solar plants will be constructed on the land in a clustered fashion and within a defined timeline, sharing common transmission and infrastructure.

The Government of Karnataka may set-up a dedicated Special Purpose Vehicle (SPV) for the development of the Solar Park. The Solar Park SPV will undertake the infrastructure development for the setting up of the Solar Park and allot the plots to the project developers eligible for participating in the schemes identified for promotion in the Solar Park.

It can be expected that the overall land development may take around 18 month period. The project life for the solar projects can be assumed to 25 years (i.e 300 months).

A broad detail of the Solar Park development framework has also been provided which indicates the key preparatory steps and the expected time for development of the Solar Park. The report also captures the possible way forward for private participation in the Solar Park and the role of the Government of Karnataka in development of Solar Park.

2 Introduction

2.1 Project Idea

Historically, fossil fuels have been the dominant source of fuel for electricity generation all over the world. This has over time, resulted in rising energy costs, energy security and climate change fears, adverse health effects and other associated environmental challenges.

The Jawaharlal Nehru National Solar Mission (JNNSM) under the National Action Plan for Climate Change aims to promote ecologically sustainable growth while addressing India's energy security challenge. The mission aims to initiate a shift from fossil fuels to renewable based generation (solar) and in the process leverage India's advantage in terms of access to abundant scientific, technical and managerial capacity to develop a new industry which in time shall not only address energy access and delivery issues in India but across the globe. The mission plans to make significant investments in solar generating capacity, manufacturing, research and development and human resources.

The National Solar Mission received unprecedented response from not only the Indian industry but also from a variety of international stakeholder's right from the time of its launch on 11th January, 2010 by the Prime Minister of India. The first two batches for the development of utility scale grid connected solar projects saw unprecedented interest from the investor community that the mission had to adopt a reverse bidding mechanism for the allocation of the projects

In line with the national agenda on solar promotion, the Government of Karnataka has already issued a separate policy named "Solar Policy 2011-16". The Karnataka Renewable Energy Development Limited (KREDL), has been appointed as the nodal agency for facilitating & implementation of the Solar Policy. The KREDL shall prepare the bidding documents, such as Expression of Interest (EoI), shortlisting criteria for Agencies, Request For Proposal (RFP), details of technical and financial aspects in the proposals, general/special conditions of contract.

The Karnataka Renewable Energy Development Limited (KREDL) is an organization working under the purview of Energy Department, Government of Karnataka. The objectives of the KREDL are to promote renewable energy (including solar energy) in the State and to initiate all necessary actions for Energy Conservation in the State. The KREDL works through various Governmental Agencies, Private Organizations, NGO's and Accredited Energy Auditors.

The Energy Department, Government of Karnataka through KREDL intends to develop Solar Parks in the state in order to encourage installation of the solar power projects for electricity generation. To facilitate the process, Govt. of Karnataka will identify the areas all across the State for setting up the Solar Parks.

The Government of Karnataka has already identified area in Village- Mannur, Taluka- Basavana Bagewadi, District- Bijapur, for setting up the solar park. Deloitte Touche Tohmatsu India Private Limited ("DTTIPL") has been appointed by the Govt. of Karnataka for undertaking the pre-feasibility study for setting up the proposed Solar Park in district Bijapur.

2.2 Approach

The development of the pre-feasibility report for the proposed solar park comprise of both technical & commercial analysis to understand the attractiveness & identify issues related to setting up of the solar park. The key aspects that are analyzed as a part of development of the pre-feasibility report include:

- Understanding of the site details (land, solar radiation, climatic conditions)
- Conceptual Planning for setting up Solar Park
- Preliminary infrastructure assessment
- Preliminary development needs
- Project Cost estimates & related benefits
- Way forward

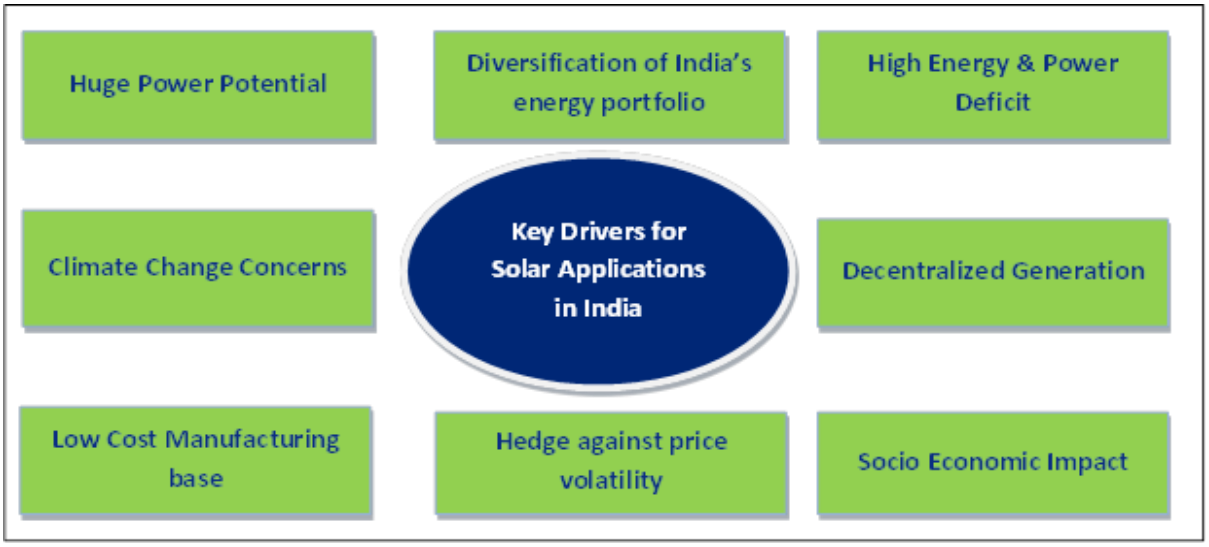
Deloitte team had detailed interactions with IDD, Energy Department and KREDL to understand the basic philosophy, purpose and goals / aspirations they intended to attain, by the development of such Solar Power Parks in the State. A visit to the proposed site in District Bijapur was also undertaken to assess various site specific details.

3 Sector Profile

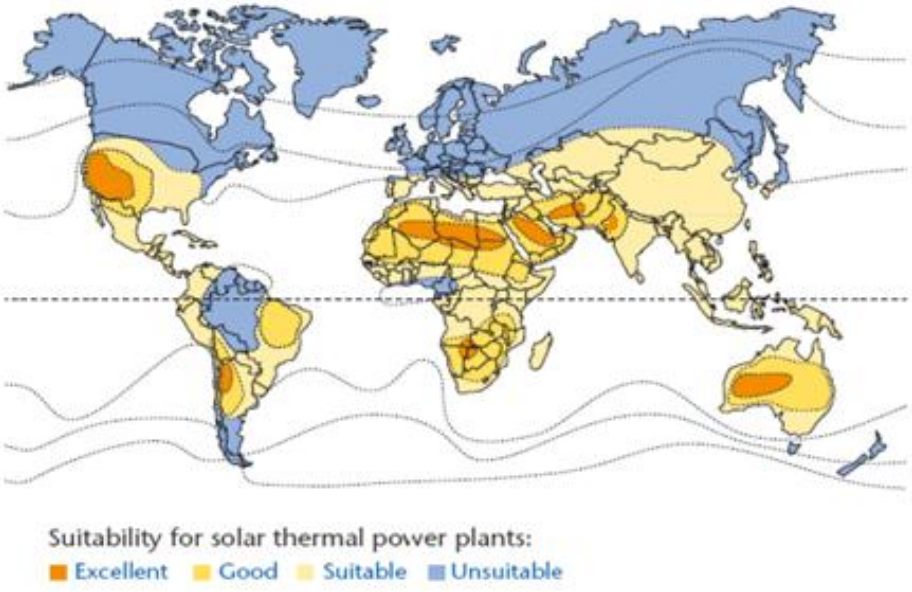
3.1 Solar Industry Overview

India receives solar energy equivalent of over 5,000 trillion kWh per year and has the potential to generate about 700 billion units annually from solar, amongst the highest across the globe. To tap this huge solar potential, India has embarked on an ambitious program under the Jawaharlal Nehru National Solar Mission (JNNSM) which is targeting an addition of 20,000 MW of solar power by 2022. The program has already received a very good response from the market under Phase I.

A number of drivers, highlighted in the diagram below are driving the development of the Indian Solar Energy sector. Some of these have been discussed in detail below:



Located in the sub-tropical belt, India receives abundant sunshine through most of the year, with many parts receiving 250-300 sunny days a year. At 1900 kWh/sq. M, India receives one of the highest levels of solar irradiance globally. India's favourable geographical position is highlighted below.



Source: Schott AG (2009)

Role of Solar Energy

The promotion of solar energy in India should be seen from a broader and long term perspective. Harnessing the solar energy offers energy security & environmental benefits and other benefits namely:

i. Contribute to enhancing power availability, reducing the energy shortage, stabilization of tail-end grid & addressing the peak demand deficit faced by the state of Karnataka.
ii. Enhancing energy security by developing diverse energy mix: Majority of electricity generation in Karnataka is based on conventional energy; solar energy can contribute towards diversifying the energy base to reduce dependence on conventional energy sources.
iii. Providing clean & reliable energy: Solar energy helps in meeting the energy requirements of people in remote rural areas.
iv. Leads to sustainable development: Promotion of solar energy will contribute directly towards the overall improvement of living standard of rural populace. It will also help maintain ecological balance, replacing conventional energy use, generate additional employment opportunities, improve health and increase access to education to rural children.

Central Promotional Programs for Solar Energy Development in India

The National Action Plan for Climate Change (NAPCC) in India was released by the Prime Minister's Council on Climate Change. In the context of solar energy NAPCC states that "India being a tropical country, where sunshine is available for longer hours per day and in great intensity, solar energy, has great potential as a future energy source. It also has the advantage of permitting the decentralized generation and distribution of energy, thereby empowering people at the grassroots level".

In light of the above, the Jawaharlal Nehru National Solar Mission (JNNSM) was launched to promote power generation from solar energy in the country. The objective of the Jawaharlal Nehru National Solar Mission is to create conditions, through rapid scale-up of capacity and technological innovation to drive down costs towards grid parity. The Mission aims at achieving grid parity for solar by 2022 and parity with coal-based thermal power by 2030.

The Mission has adopted a 3-phased approach, spanning the remaining period of the 11th Plan and first year of the 12th Plan (up to 2012-13) as Phase 1, the remaining 4 years of the 12th Plan (2013-17) as Phase 2 and the 13th Plan (2017-22) as Phase 3. The mission lays down the targets that need to be achieved in the years to come so that India can tap its solar potential to the fullest. The targets set by JNNSM have been summarized in table below.

Application Segment	Target for Phase-I (2010-2013)	Target for Phase-II (2013-2017)	Target for Phase-III (2017-2022)
Grid Solar Power	1100 MW	4000 MW	20000 MW
Off-Grid Solar Applications	200 MW	1000 MW	2000 MW
Solar Collectors	7 million sq. mts	15 million sq. mts	20 million sq. mts

During the reverse auction process for Batch I (in late 2010), 36 projects were selected, with nearly 400 developers bidding. A total of 140 MW were allocated to 28 PV projects and nearly 470 MW to seven solar thermal projects. The Indian government also migrated existing solar projects to count toward the Solar Mission, at a premium tariff of Rs 17.91/kWh ($0.45/kWh), providing an additional 84 MW of capacity.

The Indian government started the reverse auction price at Rs17.91/kWh ($0.45/kWh). The lowest bid price was Rs 12/kWh ($0.32/kWh). Since two PV projects failed to meet NVVN requirements, they were withdrawn from the process. Nineteen of the Batch I PV projects are located in Rajasthan; the others are in Gujarat, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Odisha, and Uttar Pradesh. India's

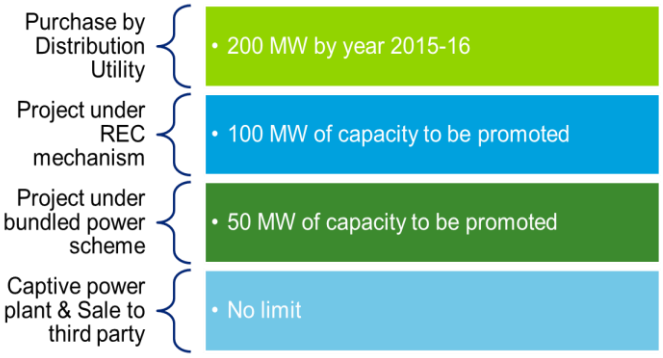
solar energy market grew from 17.8 MW in early 2010 to 506.9 MW cumulative installed capacity as of 26 March,2012[1].

3.2 Solar Profile - Karnataka

Policy Initiative for Solar Energy Promotion

Karnataka has abundant potential for development of solar energy. Under the Karnataka Renewable Energy Policy, it is envisaged that the State will have a target for achieving 126 MW of solar power up to 2013-2014. This includes the power that the State is likely to get under the JNSSM. In the meantime the KERC has issued regulations for procurement of 0.25% of total power consumed, from solar resources. The Government of India has also recently taken a decision that 0.25% of the total consumption should be from solar resources which should go up to 3% by 2022. The Govt. of India through JNNSM targets to add around 20,000 MW of solar power capacity by year 2022.

Keeping in mind the potential & benefits related to solar power promotion, the State of Karnataka has issued a separate Solar Policy 2011-16. The targets promotion of solar power under different mechanisms is detailed in the figure.



The Karnataka Renewable Energy Development Ltd. (KREDL) has already taken the initiative in line with the Solar Policy and has selected project developers by conducting tariff based competitive bidding for allocation of 80 MW of solar project capacity. The lowest winning bid was submitted at a tariff of INR 7.94/kWh.

Institutional Framework

The electricity sector in Karnataka is a major contributor to the State's growth. This sector has continuously grown and undergone major structural changes in consonance to the challenges of the changing socio-economic needs as well as the regulatory regime. The State energy sector is served by the following 100% Government owned companies.

1. **Karnataka Renewable Development Limited (KREDL)**: KREDL has been formed with a vision to promote renewable energy investments and developments in the State. This company was formed in 1997. KREDL works in close association with government owned companies, private developers, NGOs and energy auditors to promote and develop renewable energy and energy efficiency initiatives in the State. The company has allocated projects of about 16,954 MW for the State till FY 11. Out of this, around 3500 MWs of the projects have already been commissioned. **Karnataka Power Corporation Limited (KPCL)**: The Company was formed in 1970 with a view to set up a professionally managed corporation to plan, construct, operate and maintain power generation projects in the State. KPCL has been adding capacities since then in various technologies including Thermal, Hydro, Solar and Wind. The company currently has an installed capacity of 5991 MW.
2. **Karnataka Power Transmission Company Limited (KPTCL)**: KPTCL was formed when the erstwhile Karnataka Electricity Board (KEB) was unbundled into different transmission and distribution companies in the year 2002 as part of the Karnataka Power Sector reforms program. KPTCL is a transmission licensee and the State Transmission Utility as per the provisions of the Electricity Act 2003.
3. **Electricity Supply Companies (ESCOM):** The State has six distribution licensees - BESCOM, CESC, GESCOM, HESCOM MESCOM and Hukkeri Cooperative Society. These distribution licensees were created after bifurcation of KPTCL's Transmission and Distribution businesses.

[1] Source: Laying the Foundation for a Bright Future : CEEW

4. **Power Company of Karnataka Limited (PCKL)**: PCKL was incorporated on 20th August, 2007 under the Companies Act, 1956. PCKL is responsible for capacity addition by way of setting up of new power projects through bidding process, under Case-II bidding guidelines issued by Ministry of Power, GOI and long term procurement of power under Case-I bidding guidelines of MoP, GoI. In order to bridge the short term demand and supply gap, PCKL has been procuring power on behalf of the ESCOMs from various sources including purchase of power through Energy Exchange, Banking (SWAP) as well bilateral transactions. PCKL also co-ordinates with other States and Central Government agencies on power related issues as well as through the forum of SRPC(Southern Regional power Committee).

The power sector in Karnataka is regulated by Karnataka Electricity Regulatory Commission (KERC). The State Electricity Regulator started functioning in 1999, when the Karnataka Electricity Reform Act was enacted. After the Electricity Act 2003 became applicable across the country, the commission assumed its new roles and responsibilities under the purview of the Act. The prime objectives of the commission are listed below.

- To regulate all aspects of the electricity sector in an objective, professional and transparent manner.
- To safeguard consumers' interests.
- To ensure reliable, least – cost power supply as a basic input for the economic and social development of the State

3.3 Key Issues of Solar Power Development: the rationale for Solar Parks

In 2011, investments in India's renewable energy markets rose to approximately `51,000 crore ($10.3 billion), with more than one-third of the investments directed to solar projects. India's Batch II reverse auction sent ripples through international solar markets. The lowest winning bid, by the French company SolaireDirect, was `7.49/kWh ($0.15/kWh) for a 5 MW plant in Rajasthan (Year 2011) This price was impressively lower than many markets had predicted, suggesting that solar energy could attain grid parity with traditional energy sources sooner than initially anticipated. Investments are expected to double for Phase 2[2].

However, developing a solar energy project is still a complex process and for the successful development of a solar project, many things under the development process must come together. The development of solar projects face a number of issues related to land availability, financing, project development, approval & clearances. Some of these key issues are detailed below:

1. **Power Evacuation:** The availability & capacity of power evacuation infrastructure in the remote areas can be a major issue for development of solar projects, as it could result in additional burden on solar project developer on grid connectivity infrastructure.

2. **Availability of water:** The availability of water supply for solar thermal presents a huge challenge for deployment of large scale generating stations. The water supply network at the proposed site for solar projects needs to be assessed from the perspective of commercial viability of CSP projects.

3. **Land Availability**: Availability of land is a major issue faced for the development of solar power projects. Efforts need to be undertaken for identification of land for solar power development in the State.
4. **Financing**: Legal arrangements like PPA, Transmission agreement and land acquisition etc are pre-requisites to the financing and developers are supposed to utilize equity (for payment of charges/fees etc) till debt disbursements are available. This at times affects the project development as the fees/charges paid by the developers in preparatory steps are quite high. Technical capability of commercial banks in understanding the solar technology and relatively higher risks of solar projects in comparison to conventional power projects act as barrier to

[2] Source: Report : Laying foundation for a Bright Future

financing. Financial institutions perceive solar energy in India as a riskier investment because it is a fledgling industry without a proven track record in meeting commissioning deadlines, performance benchmarks, and delivering power.

5. **Project Development**: Development of projects needs to go through various administrative steps which are under various departments.

Development of Solar Park provides an integrated approach for addressing some of the key issues related to the development of solar projects. This is also results in reduced cost related to power evacuation, water availability owing the large scale solar project development in the solar park.

4 Project

4.1 Description of the Project

Concept of Solar Park

A Solar Park can be defined as a concentrated area earmarked for the development of solar generation facility over a period of time. Establishment of the Solar Parks have the potential of significantly reducing the cost of electricity from solar power due to economies of scale achieved through large scale installation and reducing a number of regulatory hurdles having possible time & cost over risk. The shared infrastructure related to power evacuation, water connectivity & other services further provides the cost advantage.

The concept aims to accelerate the development of solar power generation projects and to de-risk the dispersed solar power project investments, through the availability of large areas of suitable land, the provision of common infrastructure – including grid connection and water access – to a number of generation and manufacturing plants, as well as facilitating the permitting process. This should also enhance the financial attractiveness of such projects.

Objective of Setting Solar Park

The overall objective of setting up the Solar Park in the district of Bijapur in the State of Karnataka is to promote the development of the solar power projects for electricity generation. The overall aim is to install a capacity of around 500 MW in the solar park.

It is proposed that one or more blocks of land identified in the solar park will be allocated to different project developers in order to have a concentrated zone for solar development. Individual solar plants will be constructed on the land in a clustered fashion and within a defined timeline, sharing common transmission and infrastructure.

Guiding Principles

The concept and development of the Solar Park is based on certain guiding principles namely the mandate for solar promotion under Karnataka Solar Policy 2011-16, emerging market requirement and the industry practice.

> ***Karnataka Solar Policy 2011-16***
>
> *The State of Karnataka has issued a separate policy for the promotion of solar power named "Solar Power Policy 2011-16. The State Policy shall act as the main guiding principle for setting up of the Solar Park in the State of Karnataka. The policy targets promotion of solar projects for electricity generation through different modes including purchase of electricity by distribution utilities to meet the RPO compliance as well as solar projects under REC mechanism.*

Technology Mix

Solar Power can be generated using two key types of technologies. These are:

1. Solar Photovoltaic (PV) Technology – It collects and converts solar radiation directly into DC electricity.
2. Concentrating Solar Power (CSP) – It concentrates solar radiation to high temperatures to be thermodynamically useful for conventional thermal electricity generation plants and is also known as Concentrating Solar Thermal Power (CSP) systems.

The Karnataka Solar Policy 2011-16 aims to promote both solar PV as well as solar thermal technologies. The proposed Solar Park can be conceived with different options of solar technologies. Some of the possible options are detailed below.

S.No.	Scenario	Technology Portfolio in Solar Park	Remarks
1	Scenario 1	100% Solar PV	Solar Thermal project installation may require building water canal of approx. 30 Kms from Almatti Dam to Village Mannaur
2	Scenario 2	50% Solar PV : 50% Solar Thermal	Provide equal proportion to both technologies. If no interest for CSP, then land can be given to Solar PV developers.
3	Scenario 3	75% Solar PV : 25% Solar Thermal	Provide more weightage to Solar PV owing to the fact that Solar thermal projects require more land & water for installation.

The land requirement for the Solar Thermal projects is expected to be 0.5 hectares/MW more than the Solar PV project. Also solar thermal projects have huge water requirement. Keeping in mind the relatively higher resources requirement (land, water) by the solar thermal project, it is proposed that a Technology Portfolio of 75% Solar PV and 25% Solar Thermal can be considered for the proposed Solar Park.

Solar Scheme to be promoted

The Karnataka Solar Policy 2011-16 promotes development of solar power projects in the State

1. Sale of Energy to distribution utilities
2. Projects under Renewable Energy Certificate mechanism (REC Mechanism)
3. Bundling of Solar Power with thermal power
4. Captive solar power plants and sale to third party

The proposed solar park shall be developed by the Govt. of Karnataka. In such a scenario, it can be expected that the benefits harnessed from development of the solar park shall be passed on to the electricity consumers in the State of Karnataka. Keeping this principle in mind, the following schemes are proposed to be developed in the Solar Park:

1. **Sale of Energy to Distribution Utilities**: Solar projects selling electricity to the distribution licensees in the State of Karnataka can be encouraged to set-up projects in the proposed Solar Park. The Govt. of Karnataka has already selected 80 MW of solar power capacity (8 Solar PV projects and 2 Solar thermal projects) through tariff based competitive bidding under this scheme. The sale of power at preferential tariff to distribution utilities shall form part of the Solar RPO of each distribution utility. The table below provides an indicative analysis for the Solar RPO for different distribution utilities in Karnataka.

	Solar Obligations	FY 12	FY 13
1	ESCOMS	0.25%	0.25%
2	BESCOM	62.68	68.56
3	CESC	13.25	14.18
4	GESCOM	18.63	19.98
5	HESCOM	26.35	28.81
6	MESCOM	3.47	4.09
	Cumulative TOTAL (MU)	**124.37**	**135.62**
	Cumulative TOTAL (MW)	70.98	77.41

Source: Deloitte Analysis

2. **Projects under Renewable Energy Certificate mechanism (REC Mechanism)**: The Solar Power projects selling electricity at pooled cost of power purchase to the distribution licensees in the State of Karnataka and eligible for RECs shall also be encouraged to set-up solar projects in the proposed Solar Park. The Karnataka Electricity Regulatory Commission has already notified the REC Regulation and the pooled cost of power purchase as Rs. 2.73/unit for the Financial Year 2012 for encouraging solar power projects under REC mechanism.

3. **Bundling of Solar Power with thermal Power**: The solar projects to be installed under the bundled power concept shall also be encouraged to be set-up in the proposed Solar Park. The State of Karnataka under the Solar policy has provided for a capacity of 50 MW to the Central or Karnataka State owned undertakings for setting solar projects in the State. The power generated from the solar projects will be bundled with the thermal power.

Sizing of the Plots

The proposed solar park should promote a mix of both small as well as large capacity solar project. As assumed earlier Technology Portfolio of 75% Solar PV and 25% Solar Thermal can be considered for the proposed solar park. This indicates that for a proposed capacity of 500 MW to be set-up in the Solar Park, the following can be the capacity distribution for Solar PV and Solar thermal:

- Solar PV Capacity : 375 MW
- Solar Thermal Capacity : 125 MW

The plots in the solar park can be developed in the size of 5 MW (both for Solar PV and Solar thermal). For higher capacity projects a combination of plots can be allocated. The land requirement can be 2 hectare/MW for Solar PV technology and 2.5 hectare/MW for CSP has been considered.

The table below details the indicative area required along with the number of plots to be developed for both Solar PV and Solar Thermal projects.

S.No.	Technology	Capacity Supported (MW)	Area Required (hectares)	Individual plot Size	Number of Plots
1	Solar PV	375	750	5 MW	75
2	Solar Thermal	125	312	5 MW	25

Given the fact that the State of Karnataka has already allotted 80 MW of solar power capacity to the project developers, the initial development phase of Solar Park can be result in the installation of this allotted capacity. The later phase of Solar Park development can focus on the schemes identified for installation in the solar park.

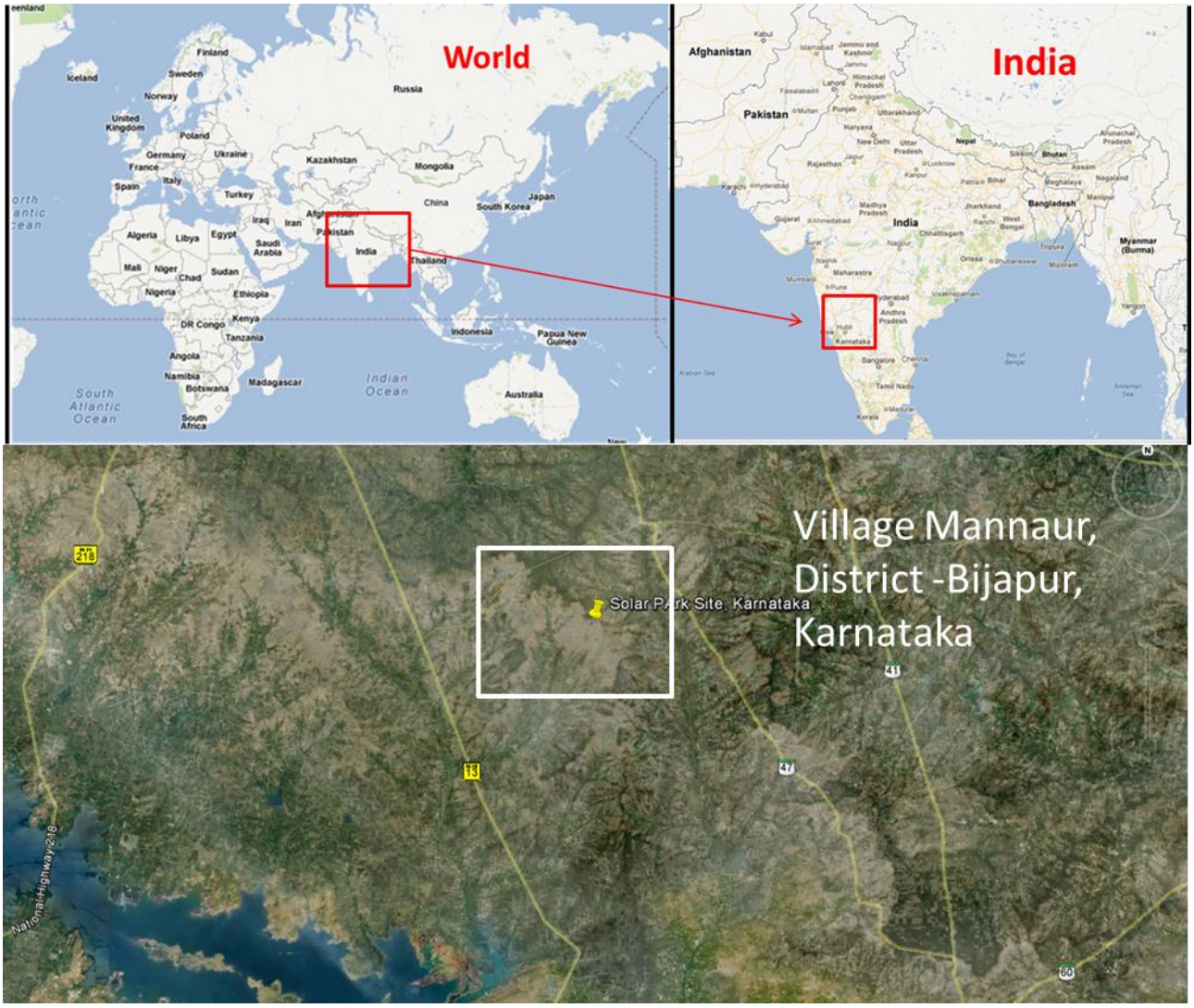
4.2 Description of the Site

This section analyses the site with an objective to understand the existing facilities and constraints to ensure effective planning of the Solar Park. The analysis is discussed in terms of location for proposed solar park, connectivity options, physical features (topography/drainage), solar radiation aspects climate and existing facilities.

4.2.1 Location and Connectivity

The Solar Park is proposed to be located in Village- Mannur, Taluka- Basavana Bagewadi, District- Bijapur. The geographical coordinates of Village- Mannur, Taluka- Basavana Bagewadi, District- Bijapur, are 16°31'54"N, 75°57'35"E. The land availability is over 1000 Acres.

The figure below indicated the area for the proposed solar park.



Source: Google Map, Google Earth

The site for the proposed solar park is located near to Basavana Bagewadi, nearest urban area, which is around 6 Kms away. The site can be accessed through a metal road from National Highway (NH)-50 (Old NH-13), which is around 20 Kms from the site. The distance matrix detailed below provides the key surrounding features from the perspective of site connectivity.

Table 1 : Distance Matrix

Details		Approx. Distance (Kms)
Nearest Urban Area	Basavana Bagewadi	6
Nearest NH	NH-50 (Old NH-13)	20

Nearest Railway Station	Bijapur	50
Nearest Domestic Airport	Sholapur	133

4.2.2 Land & Physical Features

The land, essentially barren and rocky with little or no vegetation, is near plain with higher elevation in the north east. The site does not have any perennial drainage system. A seasonal drain is located through the existing land. The ownership of the land is private.

The pictures of the proposed site in Village Mannur are shown below:

The land is predominantly flat with slopes in around one-fourth of the area. The extent of usability of the land, area available as well as the costs of land development and civil work can only be ascertained after detailed topographical survey and geo-technical investigation at the location.

4.2.3 Solar Radiation

The State of Karnataka is endowed with a good solar potential. Karnataka has about 300 sunny days in a Year. The key parameters related to analyzing the solar radiation in a particular area are Direct Normal Irradiance (DNI) and Global Horizontal Irradiance (GHI).

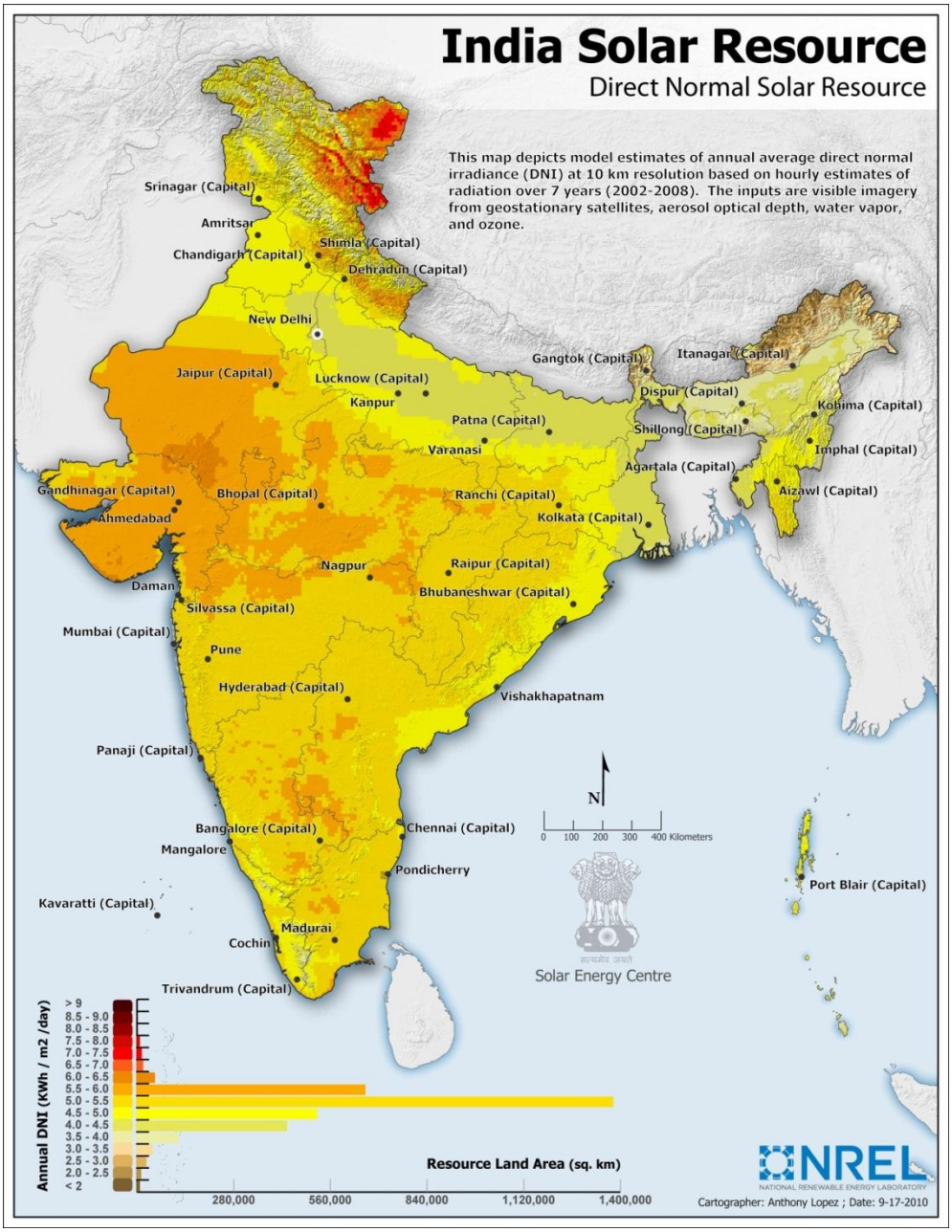
- **Direct Normal Irradiance (DNI):** Direct Normal Irradiance (DNI) is defined as the amount of direct beam solar radiation per unit area that is intercepted by a flat surface that is at all times pointed in the direction of the sun. This quantity is of particular interest to concentrating solar installations and installations that track the position of the sun.

- **Global Horizontal Irradiance (GHI):** Global Horizontal Irradiance (GHI) is defined as the total amount of solar radiation per unit area that is intercepted by a flat, horizontal surface. This value

is of particular interest to photovoltaic installations. It includes both direct beam radiation (radiation that comes from the direction of the sun) and diffuse radiation (radiation that has been scattered by the atmosphere and which comes from all directions of the sky).

The availability of solar radiation based on MNRE-NREL radiation database indicates that Karnataka has good solar radiation throughout the state. As per the prevailing technical norm, most of the places in Karnataka have DNI more or equal to 5.00 kWh/m2/day. This indicates the state is well suited for installation of both solar PV as well as solar thermal based power projects.

The figure below details the annual average Direct Normal Irradiance (DNI) across different parts of India, including regions of Karnataka.



Source : Solar Energy Centre/NREL

In Karnataka, IMD has a weather station in Bangalore, that also monitors solar radiation along with other weather related physical parameters. The table below details the annual average GHI and DNI for Basavan Bagewadi, District : Bijapur (Karnataka).

District	Taluka	Latitude (N)	Longitude (E)	Altitude	Annual Average GHI (kWh/m^2)	Annual Average DNI (kWh/m^2)
Bijapur	Basavan Bagewadi	16^o 34'59.88"	75^{o}58'1.2"	607	5.82	5.26

Source: IMD/Karnataka Renewable Energy Roadmap

Basavan Bagewadi, Bijapur has annual average GHI & DNI lesser than most parts of Rajasthan and Gujarat. This would imply that the output from the proposed park may be lower than those in Rajasthan or Gujarat. This DNI level is however, comparable to global norms, making the region suitable for installation of solar power projects if the site requirements are fully met.

4.2.4 Climate and Meteorological Conditions

Weather is predominantly dry and arid. The Climatological Table for the period : 1971 -2000 has been detailed below indicating mean values for temperature, rainfall and other aspects (hail, thunder, fog, squall) in the district of Bijapur.

Table 2 : Climatological Table : District Bijapur

Month	Mean Temperature(^{o}C)		Mean Total Rainfall (mm)	Mean Number of Rainy Days	Mean Number of days with			
	Daily Minimum	Daily Maximum			HAIL	Thunder	FOG	SQUALL
Jan	16.8	30.9	4.1	0.2	0.0	0.0	0.0	0.0
Feb	18.7	33.7	1.0	0.1	0.0	0.0	0.0	0.0
Mar	21.9	37.0	5.5	0.5	0.0	0.1	0.0	0.0
Apr	24.1	39.1	23.1	1.0	0.0	0.8	0.0	0.0
May	24.1	39.1	38.4	3.2	0.0	0.9	0.0	0.0
Jun	22.7	33.5	109.3	6.0	0.0	0.6	0.0	0.0
Jul	22.0	30.8	75.5	5.5	0.0	0.0	0.0	0.0
Aug	21.7	30.4	86.0	5.4	0.0	0.1	0.0	0.0
Sep	21.6	31.4	158.9	8.2	0.0	0.4	0.0	0.0
Oct	21.3	31.7	126.0	8.4	0.0	0.3	0.2	0.0
Nov	18.6	30.3	23.9	2.0	0.0	0.1	0.4	0.0
Dec	16.1	29.7	7.0	0.4	0.0	0.0	0.6	0.0
Annual	20.8	33.1	658.6	39.9	0.0	3.3	1.2	0.0

Source : IMD

The district of Bijapur receives maximum rainfall during the period of June to September in a particular year, with the month of September receiving the highest mean total rainfall.

The nearest Weather Monitoring station is adjacent to the 110 kV KIADB Substation of KPTCL which has recently been implemented by the Center for Wind Energy Technology (C-WET).

4.2.5 Water Availability

Surface Water

Nearest water source for the proposed Solar park can be the Almatti Dam. The dam is approximately at a distance of 30 km from the location. The river and water sharing agreements would need to be reviewed before arrangements are made to use the water for the solar park.

Rainwater

At the given site, rainfall is one of the major sources of water which is primarily used for cultivation in the nearby areas. No temporary check dams for harnessing the rainwater were observed during the site visit.

Ground water

The Ground water level is expected to be in the range of 350 ft to 400 ft. Ground water depletion and other related issues would need to be studied and analyzed in detail during Detailed Project Report (DPR) preparation

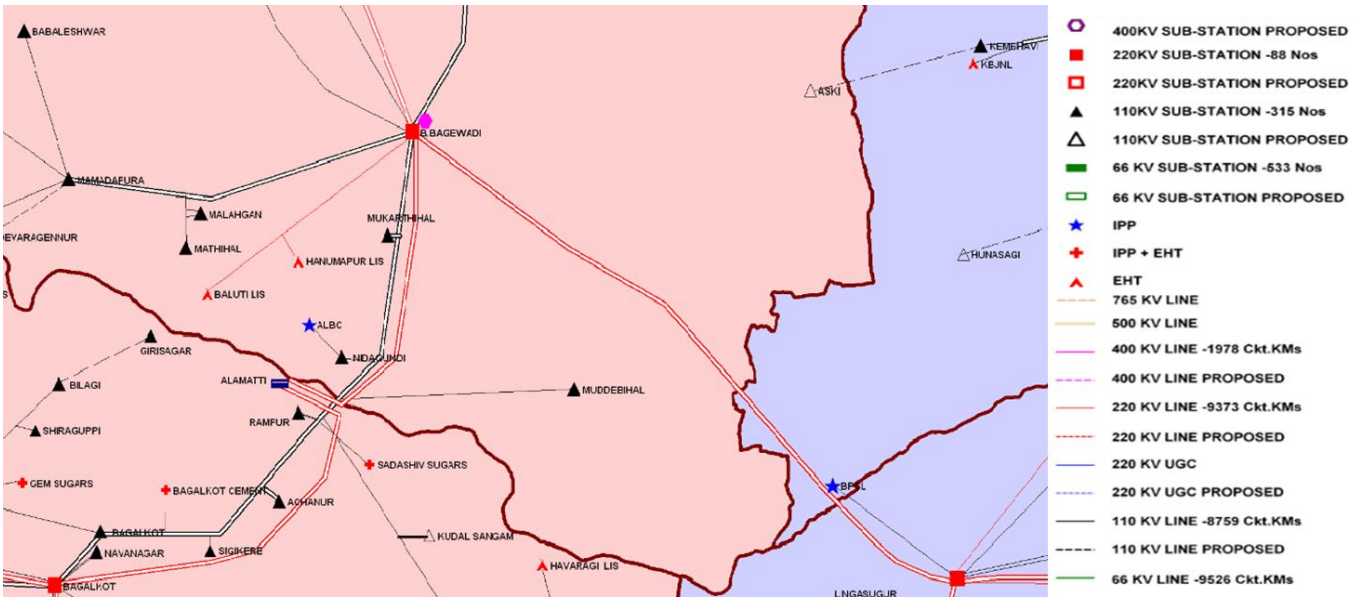
4.2.6 Grid Connectivity

The nearest substation (220/110 kV) of KPTCL is located at Basavana Bagewadi at a distance of 6 km from the location. The substation comprises 2X100 MVA Transformers.

The existing bays in the sub-station are fully utilized and new bay needs to be constructed, in case the proposed solar park is set up, for the purpose of evacuation. This may require purchase of extra land for setting up the new bay for connecting the proposed Solar Park. Securing Right of Way for the Transmission line from the proposed location can be an issue that will require further examination.

The option of Line In Line Out (LILO) on the existing 220 kV line from Almatti HEP to the Substation is at a distance of 2 kMs from site can also be explored. The LILO option may not be able to support the complete 500 MW of capacity proposed at the Solar Park. However, in case the development of evacuation infrastructure takes time, the LILO may be an option connecting the currently allocated 80 MW of the capacity, if installed in the proposed Solar Park.

The figure below details the grid map for area near Basavana Bagewadi.



Source: KPTCL

4.2.7 Telecommunication

Telecom towers are available in the vicinity of the site.

4.3 Development Needs & Planning Considerations

The development of the proposed Solar Park shall require a number of site development aspects like land acquisition, site preparation, development of the Park infrastructure and management of the Park during the construction and operating phases of individual solar projects. This section identifies the key development needs to setting up the Solar Park and the same has been detailed below.

A. Land acquisition

The Solar Park is expected to acquire land from the private owners. To acquire land from private owners, the Solar Park could either purchase the land by negotiations followed by a sale/conveyance deed, or seek government assistance to acquire the land under the eminent domain powers established in the Land Acquisition Act, 1894 ("Land Acquisition Act"), transferring the same to the Solar Park. The transfer could be in the form of either a transfer of title or a long term lease, as appropriate.

The Karnataka Industrial Areas Development Act, 1966 also provides the following provision w.r.t. acquisition of land

> *Clause 28. Acquisition of land.- (1) If at any time, in the opinion of the State Government, any land is required for the purpose of development by the Board (i.e. Industrial Areas Development Board), or for any other purpose in furtherance of the objects of this Act, the State Government may by notification, give notice of its intention to acquire such land.*

The Govt. of India is already in process of preparing a new Land Acquisition Bill. Once finalized, the Bill may provide new directions with respect to the acquisition of the land and will be applicable on acquisition of land for the Solar Park also.

The table below details the land requirement for setting up the 500 MW Solar Park.

S.No.	Technology	Capacity Supported (MW)	Area Required (hectares)
1	Solar PV	375	750
2	Solar Thermal	125	312

Land shall also be required for setting up various support infrastructure facilities like power evacuation infrastructure, roads, utility corridor, buildings, warehouse). It is assumed that around 20% of the land in the Solar Park can be kept as buffer zone for setting up the support infrastructure facilities. It is estimated that a total of around 1330 hectares (i.e. around 3286 acres) of land may be required for setting up the proposed Solar Park.

B. Land Preparation Activities

A number of land preparation activities need to be undertaken for development of the Solar Park in Village Mannaur. The key land preparation activities are detailed below:

- Land leveling : Ensure the slope of the land remains under 5% by conducting the necessary earthwork
- Site drainage : Ensure that water logging, especially during the monsoons, is avoided through the preparation of proper drainage systems
- Internal Roads: Plots need to be sun facing, therefore it is important to design the circulation in a grid pattern with roads aligned in north-south direction. Since the minimum size of the plot will be for 5 MW capacity, it is essential that it has approach from all sides to facilitate replacement of panel without much disturbances. This shall require construction of access roads capable of withstanding heavy commercial truck traffic within the Solar Park
- Development of the External Boundary Wall in the periphery of the Solar Park.

- Corridor creation : Provide space for the construction of transmission lines and water pipelines
- Development of Common Utility Buildings and Warehouse

C. Access Road

The access road to the proposed site in Village Mannaur is well connected from the NH-50 (Old NH-13) and is capable of withstanding heavy commercial truck traffic. Hence, it is assumed that not much preparation is required w.r.t connectivity from the national highway.

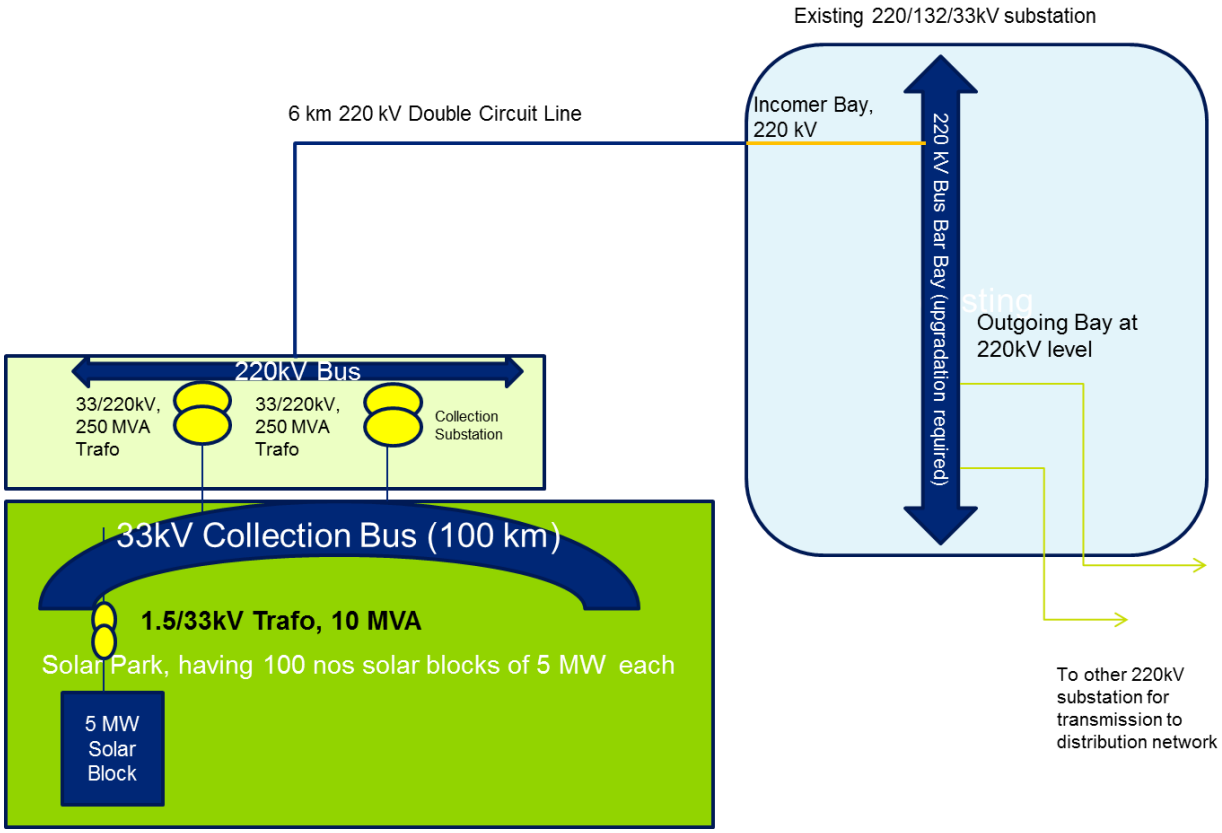
D. Grid Infrastructure

The nearest substation (220/110 kV) of KPTCL is located at Basavana Bagewadi at a distance of 6 km from the location. The substation comprises 2X100 MVA Transformers.

Strengthening of the existing bays may be required for connecting the Solar Park to the power evacuation infrastructure of the KPTCL sub-station. This may require proper planning for the power evacuation arrangement. Securing Right of Way may be an issue and need to be analyzed while preparing the detailed power evacuation plan for the Solar Park.

A typical power evacuation system consists of substations, which house generation transformers and the switchyard; transmission lines; and a step-down or step-up transformer if required at the injection point. It is proposed that the Solar Park can be connected to the nearest substation (220 kV) of KPTCL located at Basavana Bagewadi. Assuming a size of 5 MW for the plot, the solar park may require setting up a 33 kV collection bus to evacuate power from the injection points. This needs to be step-up and fed to the 220 kV Double Circuit line to transmit power to the KPTCL sub-station at Basavana Bagewadi.

The figure below details the indicative diagram for connecting the proposed Solar Park to the KPTCL 220 kV sub-station.



A new bay needs to be developed in the KPTCL sub-station to absorb the addition capacity evacuated from Solar Park (the current bay capacity may not support the Solar Park power evacuation. It is proposed that an incomer and outgoing bay can be constructed at the existing sub-station

The key details of the infrastructure required for power evacuation from the solar park is indicated in the

table below.

Item	Quantity	Unit
1.5/33kV transformers for each solar blocks	100	Nos
Switchgear required for above transformers	100	Nos
100km 33kV pole line for solar power collection throughout the solar park	100	km
33/220kV Transformers, 250 MVA	2	Nos
220 kV line	6	km
Incomer Bay at 220 kV	1	Nos
Outgoing Bay at 220kV	2	Nos

E. Water Supply System

The nearest water source for the proposed Solar Park can be the Almatti Dam. The dam is approximately at a distance of 30 km from the location. The table below details the indicative water requirement for the Solar PV & Solar Thermal projects.

S.No.	Technology	Capacity Supported (MW)	Water required /Day (MLD)
1	Solar PV	375	3.001
2	Solar Thermal	125	3.36

It can be expected that a water demand for the proposed Solar Park in the range of around 6.5 MLD.

Necessary infrastructure needs to be developed to avail of water supply from the Almatti Dam shall require developing necessary infrastructure. The table below details an indicative infrastructure requirement for meeting the water requirement for the solar park

Item	Details
Water Demand	6.5 MLD
Water Source	100% from Almatti
Elevated Storage Reservoir	1 No.(3.25 MLD capacity)
Transmission Line – 400 mm Dia pipes (External)	30 Kms
Pumps	1 Nos
DM Plant	1 Nos
Distribution Main Pipeline (Internal)	30 Kms

An elevated Storage Reservoir (ESR) can be constructed at the proposed site, water will be stored in an ESR (of 3.25 MLD capacity) to facilitate distribution by gravity. Total water requirement for power generation and cleaning of panels in the solar park is estimated at 6.5 MLD.

5 Operating Framework

5.1 Indicative Project Structure

The proposed Solar Park is expected to comprise of multiple projects having multiple ownership. Keeping in mind the scale of solar power (in MW) installation and level of initial preparatory activities required, the Solar Park will need clarity on funding, organization, responsibilities, and development timelines before the Park facility is opened for applications from prospective developers. Additional information on the Solar Park, including Board and reporting structure, legal characterization, budget, day-to-day operations, infrastructure development plans etc. will solidify the Solar Park's credibility at launch.

The project structure for the proposed Solar Park shall define the roles and responsibilities of key stakeholders involved in the development of the Solar Park. A Special Purpose Vehicle (SPV) can be set-up for the development of the Solar Park.

Functions of Solar Park SPV

The SPV shall be responsible for undertaking all the preparatory activities like land development, evacuation infrastructure, entering into appropriate contracts for development of the Solar Park. The key functions of Solar SPV are detailed below:

1. Land Purchase: The Solar SPV will acquire the land for setting up the proposed Solar Park.
2. Land Development & Civil Works: To undertake land development and civil work in the proposed site for setting up the Solar Park. This will include leveling & grading, building external boundary wall, access roads, roads within Solar Park, common utility buildings and warehouse.
3. Evacuation Arrangement: In coordination with KPTCL, set-up the evacuation infrastructure for the Solar Park.
4. Water Supply Arrangement: Set-up water supply network infrastructure to meet the water requirement for the solar projects to be set-up in the Solar Park.
5. Entering appropriate contracts/agreements : A provisional list of contracts which the Solar Park SPV entity is likely to enter is:

   Solar Park Construction Contracts

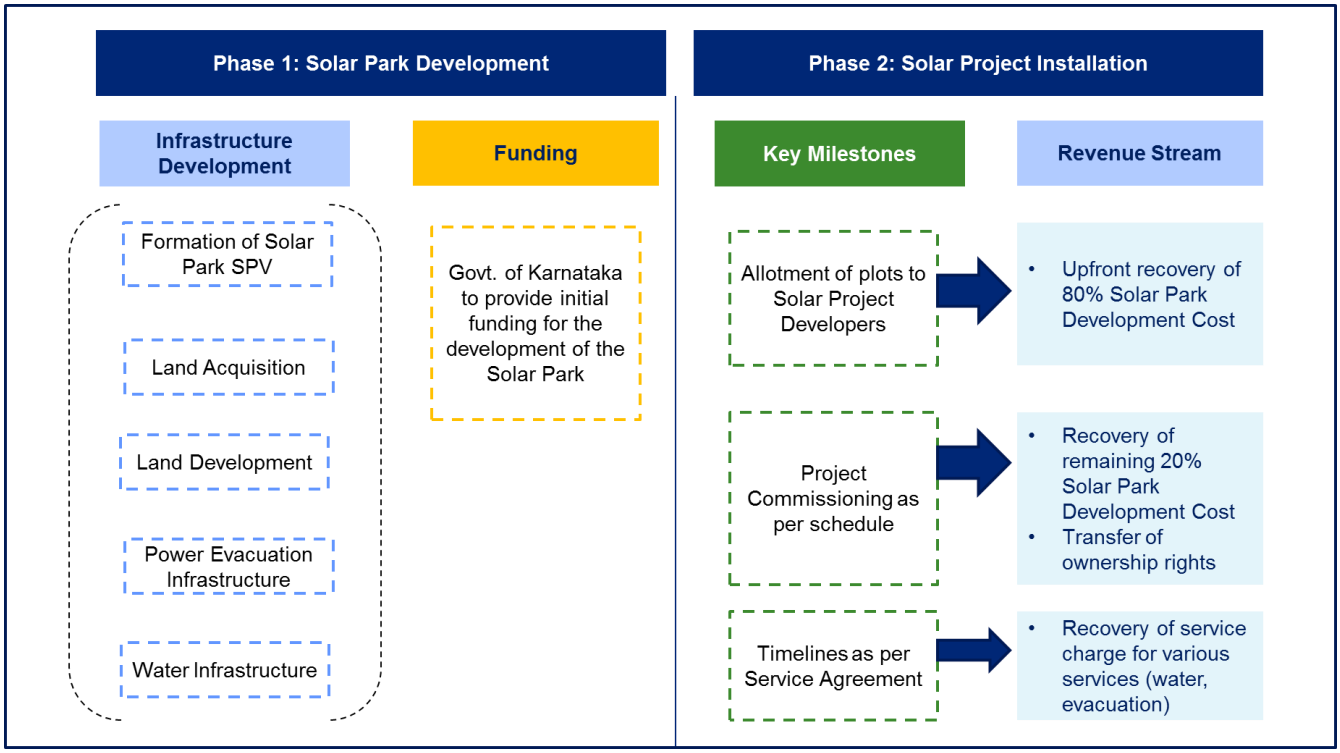
   - Grid Connection Agreement between the Solar Park and STU covering the building of transmission network and sub-station(s)
   - Water Supply Agreement for delivery of bulk water to the Solar Park
   - Water Pipeline(s) Construction Agreement between the Solar Park and an entity to be defined for the construction of water pipelines
   - Construction of the internal access road and civil works

   Solar Park Post-construction agreements

   - License Agreement with each solar project on allotment of plots
   - Services Agreement with each solar project for providing various services (water, power evacuation)

Overall Framework for Solar Park Development

The Solar Park SPV will undertake the infrastructure development for the setting up of the Solar Park and allot the plots to the project developers eligible for participating in the schemes identified for promotion in the Solar Park. The figure below details the overall framework for setting up the Solar Park and allotment of the plots to solar project developers.



Phase 1: Solar Park Development

The key steps related to the Phase – 1: Solar Park developments are:

1. **Solar Park SPV Formation:** Formation of the Solar Park SPV will be an important element of the overall development of the Solar Park. It is proposed that the Government of Karnataka may set-up a wholly owned SPV (with participation from agencies like KREDL, Water Resources Department, PWD, KPTCL) for the development Solar Park. The involvement of the Govt. of Karnataka in the initial phase shall facilitate the acquisition of land and overall Solar Park development.

2. **Solar Park Development:** The Solar Park SPV to undertake infrastructure development for setting up the Solar Park. This shall include land acquisition, land development, power evacuation infrastructure and water supply infrastructure.

3. **Funding:** The Govt. of Karnataka may provide the initial funding for meeting the funding requirement for setting up the Solar Park. A budget allocation from Government of Karnataka can be earmarked for providing the funds for undertaking the preparatory work for development of the Solar Park.

Phase 2: Solar Project Installation

The key steps related to the Phase – 2: Solar Project Installation are:

1. **Allotment of plots to Solar Project Developers**: The plots in the Solar Park can be allotted based on the competitive bidding. The bid parameter can be a one-time charge or a combination of the following:
   - Upfront Allotment Fee – One time
   - Service Charge with annual escalation

   It is proposed that the upfront allotment fee shall aim at recovering 80% of the Solar Park Development cost incurred by the Solar Park SPV. The Solar Park SPV/nominated nodal agency shall be responsible for allotment of plots adopting a competitive bidding procedure.

   The qualification requirement for participation in the Solar Park can be linked with the identified schemes (Sale to distribution licensee's, REC mechanism, bundled power) under which project needs to be implemented in the Solar Park.

2. **Solar Project Commissioning & Transfer of Ownership:** Upon allotment of the plots to the solar project developer, it is expected that the project is commissioned within the specified timelines.
   On commissioning of the project, the Govt. of Karnataka may recover the remaining 20% cost related to the Solar Park Development. Upon receipt of the same, the Govt. of Karnataka may transfer the ownership in the Solar Park SPV to the solar project developers. It can be expected that Solar Park SPV will continue operating as an entity and having separate service agreements with project developers for providing various services (water, power evacuation)

5.2 Solar Park Development Framework

The Solar Park SPV will need to undertake different preparatory activities for setting up of the Solar Park and timely allocation of the plots in the Solar Park to the solar power project developers. The key steps to include the solar park development are Land Purchase, Clearance Procedure, Land Development, Transmission System Development and Water System Development.

The table below details the time required for undertaking different preparatory work for Solar Park:

Table 3 : Time duration - Preparatory Activities

		Unit	Duration
1	Land Purchase	Months	4
2	Clearance Procedure	Months	2
3	Land Development	Months	12
4	Transmission System Development	Months	12
5	Water System Development	Months	8
A	**Total Development Period**	Months	**18**
B	**Site operational date**	Months	**1**
C	**Operation Period**	Months	**300**

It can be expected that the overall land development may take around 18 month period. The project life for the solar projects can be assumed to 25 years (i.e 300 months). The above timelines are indicative and are subject to actual implementation; especially aspects like land purchase may be take more time depending upon the local support.

The Solar Park SPV will need to submit an application to KPTCL specifying the Park's target capacity, location, and timelines at the earliest possibility in order to enable KPTCL to commence detailed planning and implementation of transmission infrastructure. It will be important for KPTCL to endorse a timetable that specifies the following:

- Approval of grid connection plan and budget by KPTCL
- Start of transmission line construction
- Start of substation construction
- End of transmission line construction
- End of substation construction

The Solar Park SPV will need to contract with concerned department (Water Resources Department) for the provision of the requisite amount of water. This will require a formal commitment after the submission of an application by the Solar Park to the concerned department.

On receipt of water allocation, the Solar Park SPV will need to contract with a pipeline construction company to install and maintain the pipeline and any other requirements necessary to take water from a pre-designated off-take point to the point of use in the solar park. The DPR to be developed shall assess the feasibility & specification of the same.

Individual project developers are expected to contract with the Solar Park SPV through a services agreement to access water from different points located within the Park. A water storage reservoir may also be required to be constructed to accommodate a minimum days of water requirements due to potential shortfalls in supply.

The Solar Park SPV shall also be required to undertake various approvals & clearances from the concerned department for development of the Solar Park.

6 Project Financials

6.1 Cost of Solar Power

There are multiple technological options such as solar photo-voltaic (using different materials such as thin film, poly-crystalline, amorphous, silicon etc.) and concentrated solar thermal (dish, parabolic, tower) available in the market. Each such technology has different efficiency and performance parameters. Moreover, project cost structure also differs significantly from one solar power project to another.

Solar PV and Solar thermal technologies have been promoted under the regulatory framework in India and the Electricity Regulatory Commission have been providing separate tariff for promotion of these technologies.

The Karnataka Electricity Regulatory Commission (KERC) has also issued a separate tariff for promotion of solar PV and solar thermal technologies. The table below detailed the key cost structure and tariff approved as per the KERC Solar Tariff Order (13.07.2010).

	Key Details	Solar PV	Solar Thermal
1	Capital Cost/MW- Rs. Crore	15.50	13
2	Capacity Utilization Factor (CUF)	19%	23%
3	ROE (%)	16%	16%
4	Auxiliary Consumption	0%	8%
5	***Tariff (Rs/kWh)***	***14.5***	***11.35***

The solar technologies especially (Solar PV) have witnessed considerable technological advancements which have resulted in the cost reduction over the years. In the recent tariff order by the Central Electricity Regulatory Commission (CERC) applicable for the period FY 2012-13, the capital cost of Rs 10 Crore/MW has been considered for the Solar PV project. The table below details the cost structure adopted by the CERC for Solar PV and Solar Thermal projects.

	Solar PV Cost Estimates	Rs Crore Per MW
1	Land Cost	0.16
2	Civil and General Works	0.90
3	Evacuation Cost upto Inter-connection Point	1.00
4	Preliminary & pre-operative expenses	0.80
5	PV Modules	4.50
6	Mounting Structures	1.00
7	Power Conditioning Unit	0.98
8	Auxiliaries	0.66
	Capital Cost Total	**10.00**
	Solar Thermal Cost Estimates	**Rs Crore Per MW**
1	Land Cost	0.19
2	Civil and General Works	0.40
3	Preliminary & pre-operative expenses	1.41
4	Solar & Power Block	11.00
	Capital Cost Total	**13**

The CERC has assumed a land cost of Rs 3 Lakh/acre for calculating the capital cost for the Solar PV and Solar Thermal projects. It is expected that the development of Solar Park shall assist in setting-up some of key infrastructure (land, power evacuation, water) required for installation of the solar power projects.

6.2 Solar Park - Cost Estimation

This section details the cost estimates of various infrastructure components to be developed in the proposed Solar Park. The cost estimates are based on the assumptions considered for development of different infrastructure requirement detailed in the previous section.

Components of Project Cost

The break-up of project cost estimates have been made under the following headings:

- Land acquisition
- Land Development consisting of Leveling & Grading, External Boundary Wall, Roads within Park, Common Utility Buildings and Warehouse
- Water Supply System
- Transmission System

Basis of Cost Estimates

The cost estimates for various components of infrastructure development are considered based on various inputs namely:

- Consultants Database
- Market quotes
- Cost considered in Similar Projects
- Land Cost based on interaction with Basavana Bagewadi Tehsildar, Department of Stamps & Registration (Govt. of Karnataka) Website, Central Electricity Regulatory Commission assumptions

Break-up of Project Cost

Preliminary estimates of the overall cost of infrastructure development indicate a total cost in excess of Rs 340 Crores for the 500 MW Solar Park in Village Mannur. These are indicative costs only and need to be refined and validated following the preparation of the site Detailed Project Report (DPR). The indicative break-up of the project cost is detailed below in the table.

Table 4 : Indicative Break-up of Solar Park Project Cost

	Site Development	Cost (Rs Crore)	Remarks
A	**Land Cost**	99	Land purchase of around 3286 acres of land required (CERC assumption of Rs 3 lakh/acre considered for land cost calculation)
B	**Land Development Cost**	97	To Include aspects like Leveling & Grading, External Boundary Wall, Roads within Park (Side road), Roads within Park (Main Road), Common Utility Buildings, Warehouse
C	**Transmission Network within Solar Park**	118	Transmission network within the Solar Park to include 1.5/33kV transformers for each solar blocks, Switchgear required for transformers, 100km 33kV pole line for solar power collection throughout the solar park, 33/220kV Transformers, 250 MVA
D	**Water supply network**	26	Water supply network infrastructure to include Canal Head Regulator, Sump and Pump House, Transmission Pipeline from water source, Distribution Network within solar park and and Elevated Storage Reservoir (ESR), DM Plant
	Total (A+B+C+D)	**340**	

Based on the analysis, the indicative cost related to the development of the infrastructure for setting up the Solar Park will be around Rs 340 Crores. The land cost has been assumed at Rs 3 lakh/acre as per the assumption of the CERC for calculating the capital cost for Solar PV and Solar Thermal projects.

Most of the cost related to the development of the Solar Park shall be borne by the project developers. However, some aspects like power evacuation infrastructure outside the Solar Park can be funded and built by KPTCL. As per the Karnataka Electricity Regulatory Commission Solar Tariff Order (2010):

- *"State Transmission Utility (STU) has to plan for economic and efficient intra-state transmission system. As such, the STU shall take responsibility to evacuate power from the interconnection point. Further, STU/ESCOMs shall not collect any network augmentation charges towards system augmentation beyond the interconnection point. The developer shall be responsible for providing evacuation facility upto the interconnection point"*

Under the current system, STU recovers the cost of transmission infrastructure build-out by recovering transmission charges from the DISCOM purchasing the power.

6.3 Scenario Analysis

As per the initial assessment, private land needs to be acquired for setting up the proposed 500 MW solar park. The cost of land shall be an important element impacting the cost to be recovered from the project developers setting up project in the solar park.

A scenario analysis has been undertaken to indicate the cost per MW required for developing infrastructure assuming different rate of land cost. Three scenarios have been considered assuming CERC assumptions, Govt. rate - based on interaction with Tehsildar and Department of Stamps & Registration (Govt. of Karnataka) Website - Non-Agricultural land cost for Mannaur Village. The table

below details the results of the scenario analysis.

	Details	Case -1 (CERC land cost Assumptions)	Case-2 (Govt. rate - based on interaction with Tehsildar)	Case -3 (Non-Agricultural land cost for Mannaur Village – Source : Department of Stamps & Registration (Govt. of Karnataka) Website - as on 26 May 2012)
1	Land Cost (Rs Lakh/acre)	3	0.8	16.1
2	Area Required (Acre)	3,286	3,286	3,286
3	Total Land Cost (Rs Crore)	99	26	530
4	**Total Solar Park Development Cost (Rs Crore)**	**340**	**267**	**771**
5	Total Capacity proposed (MW)	500	500	500
6	**Cost per MW (Rs Crore)**	**0.68**	**0.53**	**1.54**

The sensitivity on the land cost indicates that the cost per MW can vary from 0.53 Crore to 1.54 Crore for setting up a 500 MW solar power capacity.

The proposed site for the Solar Park has close proximity to support facilities like KPTCL sub-station, access road and water at Almatti dam. The above cost analysis is indicative and the preparation of the Detailed Project Report (DPR) shall assist in validating the detailed cost elements for setting up the solar park.

6.4 Benefit Analysis

Govt. of Karnataka

The proposed Solar Park is expected to provide various environmental & economic benefits, apart from adding to the power capacity of the State. The setting up of the Solar Park shall require initial support from the State Govt. of Karnataka. One of the critical elements shall be to provide financial support in the form of initial funding for infrastructure development in the Solar Park. A budget allocation from Government of Karnataka can be earmarked for providing the funds to the Solar Park SPV for undertaking the preparatory work for development of the Solar Park.

Once the Solar Park is fully developed, it is assumed that the Govt. of Karnataka (through Solar Park SPV) shall recover the initial funding provided from the infrastructure development in the Solar Park from the solar project developers setting up solar power projects in the Solar Park. The mode of recovery for the funding support provided for Solar Park by the Govt. of Karnataka can be:

1. The infrastructure development cost (except land cost) in the Solar Park is expected in the range of 70% to 80% of the total cost for Solar Park Development. It is proposed that the Govt. of Karnataka (through Solar Park SPV) may recover around 80% of the total Solar Park development cost upfront from the solar project developer at the time of allotment of plots for installation of solar power project.

2. The land cost may form 20% to 30% of the Solar Park development cost. It is proposed that the remaining 20% of the total Solar Park development cost can be recovered from solar project developers at the scheduled date of commissioning or actual commissioning date (whichever is

lower).

This shall ensure that the Govt. of Karnataka is able recover the initial funding provided for the development of the Solar Park. The proposed project is also expected to create job opportunities for the local population, especially at the initial stages of the Solar Park infrastructure development.

Solar Project Developers

The proposed Solar Park of 500 MW can significantly reduce the cost of electricity from solar projects through:

- economies of scale
- the removal of regulatory/permitting hurdles
- shared infrastructure and planning
- the mobilization of low-cost financing for solar project developers
- proximity to transmission network, access road may provide cost advantage to the solar project developer

The two differences for a project located in the Solar Park will be the reduction in development risk, given the local government commitment to build Solar Park, provide common infrastructure and facilitate the project permitting & clearances process.

This shall act like an important risk mitigation measure from the perspective of the project developers. This risk mitigation may also translate into lower risk premiums from equity investors and/or induce developers to apply for an allocation of land within the Solar Park.

7 Indicative Environmental & Social Impacts

7.1 Environmental Impacts

The MoEF has excluded solar based power plants from their purview of environmental clearance and EIA as it does not use any fuel and do not contribute to environmental pollution, especially air pollution. Further, use of water in the park may be negligible and therefore water effluent handling may not be a major task. The solar power projects need to obtain only No Objection Certificate / Consent to Establish from the State Pollution Control Board as per the State guidelines. It needs to be ensured that there will not be dumping of any type of waste in the site area.

Also, based on the site visit and interaction to local authorities no Forest reserve or wild life sanctuary was identified near the proposed solar park.

7.2 Social Impacts

The site is free of habitation and there are no major permanent structures. Therefore, there is no issue of relocation and rehabilitation. However, development of the site will involve acquisition of private land. During the site visit, some tracts of agricultural land were also identified within the proposed site. The impact of same needs to be further analyzed as a part of the Detailed Project Report (DPR).

7.3 Mitigation Measures

Some of the key environmental/social issues related to the development of proposed Solar Park can be mitigated. This can include the following:

1. The arid and dusty environment may pose a risk for both worker population and efficient operation of the solar panels. A bed of shrubs all across the site to reduce the impact of dust.
2. Acquisition of private land to be managed properly. The nodal agency for the proposed solar park may take initiative to involve local population in the project. This may include
    a. Employment to local residents for unskilled and semi-skilled activities.
    b. Provision of Buffer/green belt.
    c. Provision of Rain Water Harvesting.
    d. Provision of solar lighting in Panchayat house, school building etc.
    e. Provision of solar street lighting system for Village.
3. Detailed Environment & social impact assessment may be undertaken while preparing the Detailed Project Report (DPR) for the proposed Solar Park.

8 Statutory & Legal Framework

India has a number of legislations, policies and regulations which have been put in place to govern the electricity sector in the country including areas such as renewable sources, sustainable development, energy efficiency and conservation etc are covered under these framework. The key legislations & policies include The Electricity Act 2003, National Electricity Policy (NEP 2005), National Tariff Policy (NTP 2006) and the Integrated Energy Policy 2006. The policy & regulatory framework has provided for the a number of instruments like Feed-in tariff, Renewable Purchase Obligation (RPO) & Renewable Energy Certificate (REC) for promotion of renewable energy sources including solar energy.

The most proactive support being provided to renewable energy developers at state level is through the State Electricity Regulatory Commissions. The SERC's have chosen a host of measures and instruments to promote renewable energy including solar energy development.

Tariff

The Karnataka Electricity Regulatory Commission (KERC) has undertaken various steps for promoting non-conventional/renewable sources of energy like the feed in tariffs. As mandated by the Electricity Act 2003 and the National Tariff Policy, the KERC has issued tariff order & regulations for facilitating procurement of power by grid from non-conventional sources including solar energy.

The table below details the preferential tariff determined by the KERC for solar power projects:

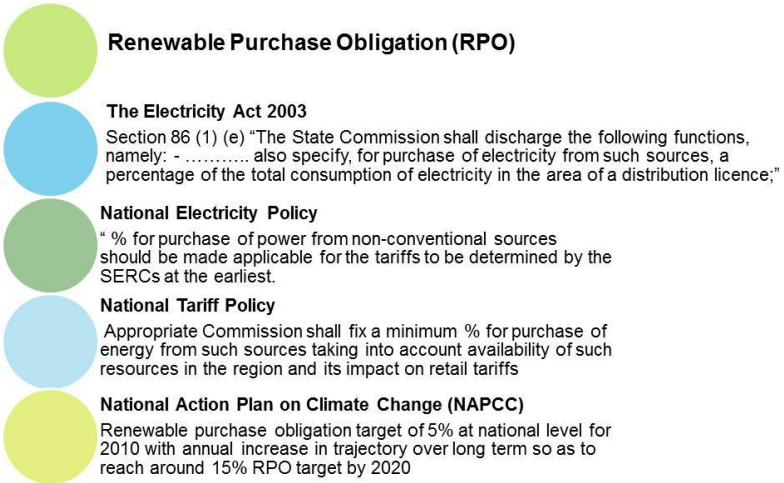
	Type	Tariff (Rs/kWh)
1	Solar PV Power Plants	14.50
2	Solar Thermal Power Plants	11.35
3	Rooftop Solar PV and other Small solar power plants connected to Distribution network at voltage levels of below 33KV	14.50

Source: KERC Solar Tariff Order 2010

The purchase of electricity by the distribution licensees from solar projects is governed by the KERC Solar Tariff orders. The KERC determined tariff is the maximum tariff rate for purchase of electricity from the Solar and acts as a cap for undertaking tariff based competitive bidding for selection of solar project developers.

Renewable Purchase Obligation (RPO)

In the interest of long term development of renewable energy sector, the Karnataka Electricity Regulatory Commission has taken the initiative to promote Renewable Energy (RE) by specifying a minimum/base renewable energy procurement obligation as per the provisions of Electricity Act 2003 and other policies. The Renewable Purchase Obligations (RPOs) ensure that the obligated entities procure a certain minimum percentage of their total power requirement from renewable energy sources.



The RPO targets have been defined by a number of states in the form of Solar RPO and non-solar RPO targets for obligated entities. The table below details the RPO specified by the KERC on the distribution utility :

ESCOM	RPO for RE sources other than Solar	Solar RPO
BESCOM	10 %	0.25 %
MESCOM	10 %	0.25 %
CESC	10 %	0.25 %
HESCOM	7 %	0.25 %
GESCOM	7 %	0.25 %
Hukkeri Society	7 %	0.25 %

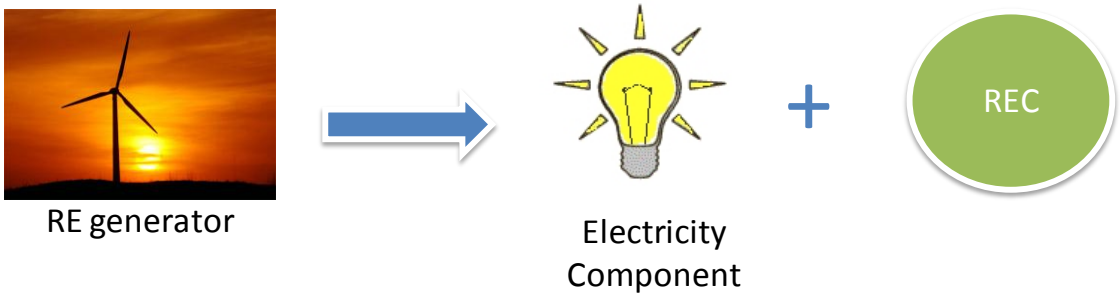
Source: KERC (Power Procurement from Renewable Sources by Distribution Licensee and Renewable Energy Certificate Framework) Regulations, 2011

The RPO % is applicable on the total electricity consumed within the distribution licensee area. The purchase of electricity by the distribution licensees from solar projects is governed by the KERC regulation on Solar RPO. As shown earlier, the Solar RPO on all distribution licensee's in Karnataka is around 136 MU and could support a capacity of close to 80 MW.

Renewable Energy Certificates (RECs)

Several states have issued the RPO obligation but still a number of issues are being faced in the effective implementation of RPO. Some of the issues are lack of compliance in a number of states due to low installed capacity; compliance met & obligated entities not willing to procure more electricity from RE sources, high transaction cost to meet RPO compliance for open access and captive consumers.

Renewable Energy Certificates (RECs) can play vital role to address the issues related to the effective implementation of RPO and facilitate the scaling up of renewable energy in country. A "Renewable Energy Certificate" is a commodity representing the environmental attributes of a unit of renewable energy. The electricity generated from RE based power projects (eligible under REC framework) will comprise two components: Electricity component and RE attribute in the form of REC.



As per the Central Electricity Regulatory Commission (CERC) REC Regulation there are two categories of REC's: 1) Solar and 2) Non-solar. Solar RECs are issued to eligible entities for generation of electricity based on solar as renewable energy source, and non-solar RECs are issued to eligible entities for generation of electricity based on renewable energy sources other than solar.

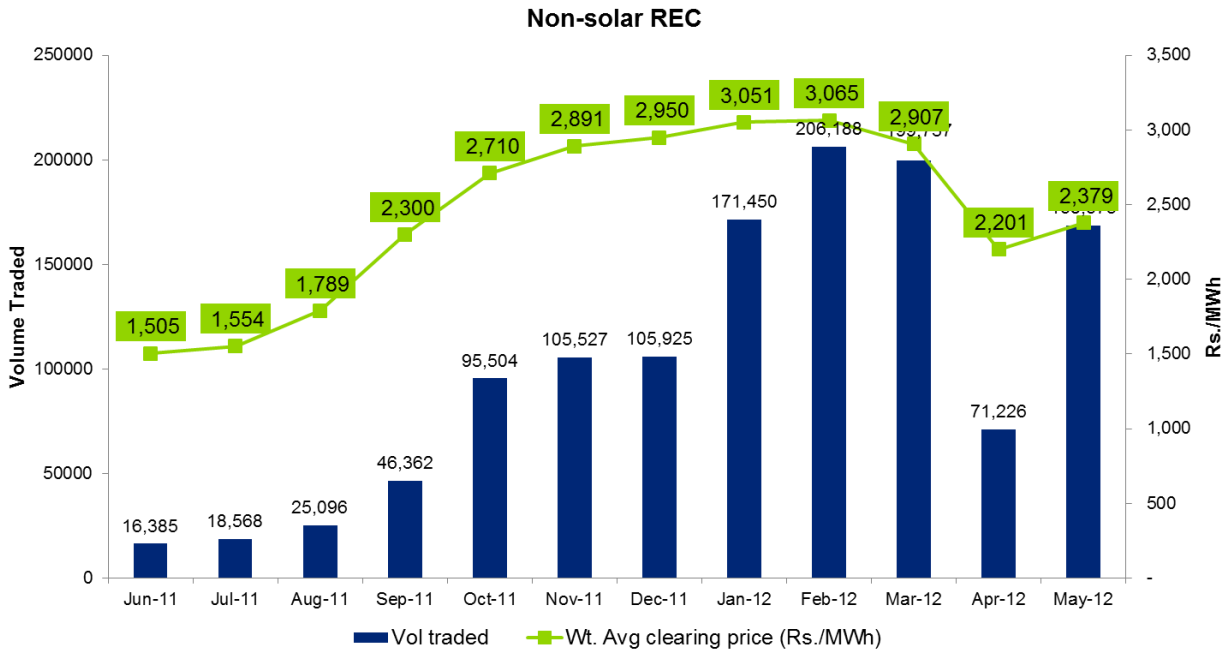
The price of the REC is market determined and will be in the range specified by the CERC. The CERC provide for the floor price and forbearance price separately for solar and non-solar certificates which are subject to review after every control period. The REC's are traded between the floor and forbearance price specified by the CERC.

The table below details the floor & forbearance price for REC specified for FY 2012 and for FY 2013 to FY 2017:

Table 5 : REC Trading Price Band (Rs/ MWh)

Rs/MWh		FY2012	FY 2013 to FY 2017
Non-Solar REC	Forbearance	3900	3300
	Floor	1500	1500
Solar REC	Forbearance	17000	13400
	Floor	12000	9300

The RECs are traded in the power exchanges in the India within the price band specified by the CERC. The figure below details the volume and the weighted average price of the Non-Solar RECs.



The trading has undertaken primarily for the Non-Solar RECs in the REC market currently. As of now, only 10 Solar RECs have been traded at a price of Rs 13000 per REC. The reason for the current low level of Solar RECs is that most of the currently installed capacity is under sale of electricity to distribution licensee at preferential tariff, which does not qualify for Solar RECs. With the deceasing cost of electricity generation witnessed in the solar projects, it can be expected that more solar power capacity will come under the Solar REC mechanism.

9 Way Ahead

1. Amendment of Solar Policy to accommodate Power purchase structure for Solar Park

- Need to expand the Karnataka Solar Power Policy to accommodate the 500 MW capacity proposed to be installed in the Solar Park.

2. Appointment of Technical Consultant

The Govt. of Karnataka may appoint a Technical Consultation to prepare a Detailed Project Report (DPR) for the proposed Solar Park. The DPR is expected to include various aspects in detail, like:

- Technology Evaluation
- Resource Assessment
- Preliminary Yield Analysis
- Conceptual Planning
- Environment & Social Impact Assessment
- Infrastructure Plan
- Project Cost Estimates

This activity will address the infrastructure development necessary for the Village Mannaur site, which has been identified as the initial location of the Solar Park. The detailed plan should be refined in conjunction with prospective developers once initial expressions of interest have been received in relation to the participation for setting up solar power projects in the Solar Park, with a focus on the build-out of approximately 500 MW of solar generation capacity in Mannaur.

3. Setting up of Solar Park SPV

- The Govt. of Karnataka to set-up a Special Purpose Vehicle (SPV) for the overall development of the Solar Park.

4. Land for the Solar Park

- Acquisition of the private land for setting up the Solar Park

5. Selection of Project Developer for Solar Park through Competitive Bidding

The Solar Park SPV/nodal agency may adopt a competitive process for the selection of the project developer for the allotment of plots for setting up solar projects under different models as discussed in Section 8. The implementation steps for a PPP project, irrespective of the model being used, are enumerated as under:

(a) **Completion of Preparatory works**

Based on DPR prepared, the Govt. of Karnataka may decide the model to be adopted for implementation and level of support to be provided to the Solar Park. The preparatory works also include formation of a project monitoring committee, bid process co-coordinator and bid evaluation committee.

(b) **Finalization of bid documents**

Bid documents viz. RFQ, RFP, Leasing Agreement/Concession Agreement need to be formulated for selection of the private entity. The bid documents to clearly specify the selection criteria, details of bid evaluation parameter which can be dependent upon Upfront Allotment Fee – One time and Service Charge with annual escalation.

(c) **Invitation of bids**

Bids need to be invited based on the timelines as provided under the bidding guidelines. These timelines are for a two stage process comprising of RFQ and RFP bids. Bids are invited by the bid process coordinator.

(d) **Pre-bid conference**

Pre-bid conference is required to address the bidder's queries at each stage of bid process. Depending upon the complexity of the projects, number of pre-bid conference can be more than one.

(e) **Evaluation of Bids**

Bid evaluation is usually done by a bid evaluation committee and the report submitted by the evaluation committee completes the evaluation process resulting in award of letter of award to the successful developer.

(f) **Signing of Agreement**

The selected developer has to sign the agreement with the beneficiary within the specified timeframe from the issuance of Letter of Award.