A
Revised Detail Project Report (R1)

on

Proposed 765 kV Double Circuit Transmission Line from Khavda to Bhuj PSS1

for

Proposed 3.5 GW Hybrid (Wind-Solar) Park

Near Rann of Kutch at Village Khavda,

District Kutch, Gujarat

By:

adani

Renewables

ADANI GREEN ENERGY THIRTY LTD.

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January 2021

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1. GENERAL INFORMATION

Government of India has set a target of reaching **175 GW** of installed capacity from renewable energy sources by the year 2022, which includes 100 GW from Solar, 60 GW from Wind and 15 GW from other renewable sources. In order to achieve the target, various Solar, Wind, Wind-Solar Hybrid policies have been enunciated by Central and State Governments. Gujarat is the leading front runner state, implementing large capacity renewable projects under these policies.

In order to provide support to development of large scale renewable energy projects, the state of Gujarat has issued a policy for allotment of revenue waste land to the Park developers. In accordance with the Gujarat Government policy "Allotment of Government waste / barren land for the purpose of raising Renewable Energy Generation Park", **Adani Green Energy Limited** (referred as **AGEL**) has planned to develop 10,000 MW Wind-Solar Hybrid Park in Kutch district of Gujarat. **Adani Green Energy (Four) Limited** (referred as **AGE4L**), a subsidiary of AGEL has won the Bid of **8 GW** capacity Manufacturing Link of Solar Power Plant from SECI. Out of these 8 GW, for phase –I AGE4L has proposed to develop and connect 3.5 GW capacity of Solar Hybrid Park to the GRID by developing plant near Rann of Kutch, Khavda Village, District Kutch of Gujarat. For power evacuation of the proposed project, a special purpose vehicle "**Adani Green Energy (Thirty) Limited** (referred as **AGE30L**) has proposed to develop and operate **765 kV Double Circuit Transmission Line** connecting Switchyard at Khavda to the Pooling Substation (PSS1) of **Power Grid Corporation of India Limited** (referred as PGCIL) at Bhuj. The proposed Solar Hybrid Park will require an estimated area of approx. **20,000 hectare** of land. The entire land identified for the park is barren revenue wasteland. Hybrid projects within the Proposed Wind-Solar Hybrid Park are also envisaged to be developed by AGEL and/or its subsidiaries as the Project Developer.

Solar and Wind Power generation depends on solar irradiation and wind velocity respectively, which fluctuate based on weather conditions. As a result of these variations, Solar and Wind Power Plants do not operate at their peak installed capacity generally. Hence the overall infrastructure of a typical renewable energy plant is not optimally utilized.

Many studies have been carried out recently to evaluate feasibility of implementing Wind and Solar Hybrid Power Plants. These studies revealed that in certain regions of India, Solar and Wind resources are complementary to each other. Also, hybridization of these two renewable

energy sources would help in minimizing the variability and optimally utilize the infrastructure including land and power evacuation system.

National Institute of Wind Energy (NIWE) has conducted Onsite Data comparison of Wind and Solar Energy at **14 locations** in India. Superimposition of wind and solar resource maps shows that the region of Kutch in state of Gujarat has very good potential for both Wind and Solar power generation.

The data obtained from various Solar Databases indicate an annual daily mean of 5.59 kWh/m2 global horizontal irradiation in the region. This is amongst the mid-range brackets of irradiation received on the Indian subcontinent. The data obtained from International Renewable Energy Agency (IRENA, 2014) estimates wind speed of 6-7 m/s for this region at 80 m above ground. This indicates that Kutch region areas has very good potential for setting up Hybrid Wind-Solar power plants.

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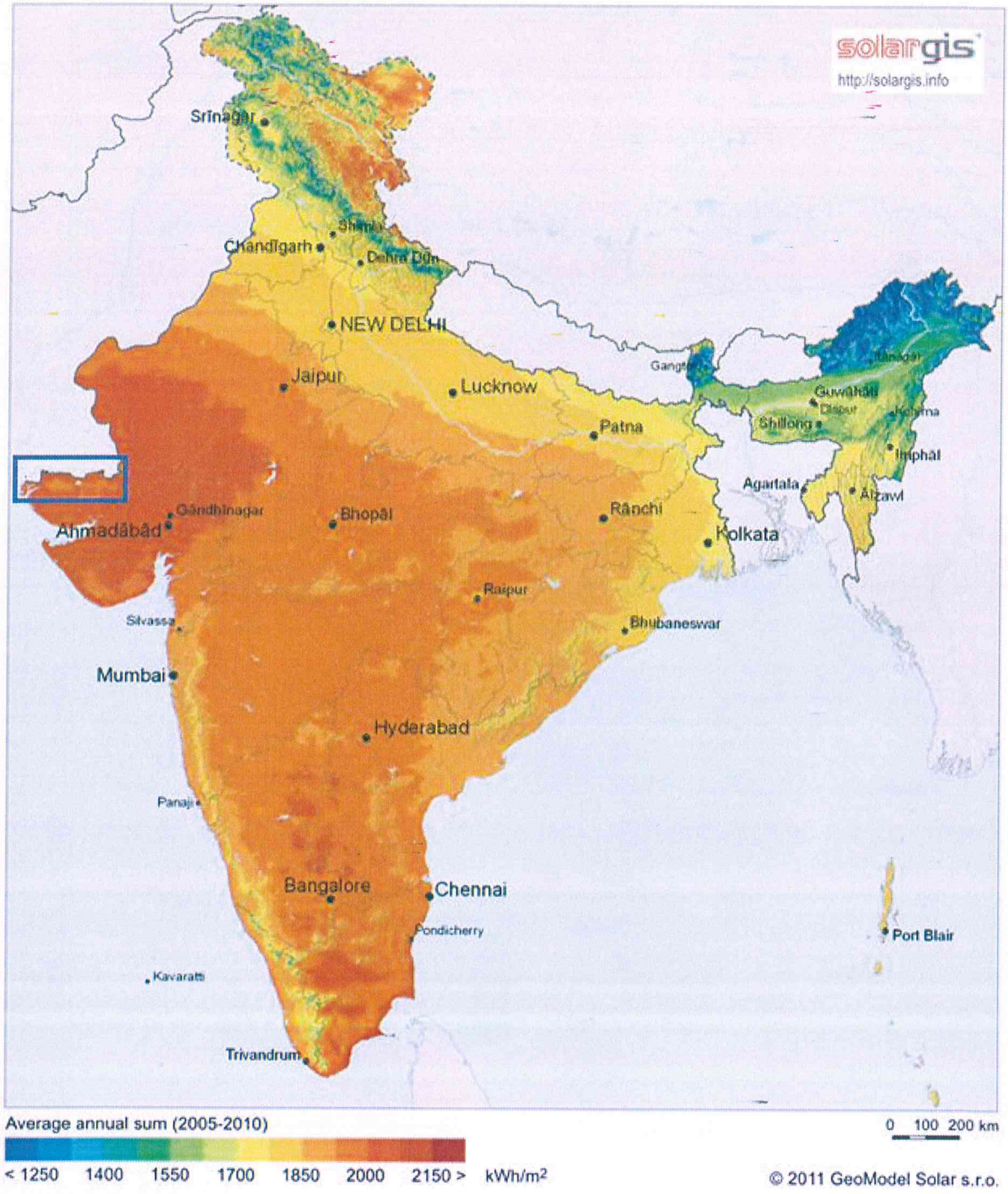

Figure 1: Global Horizontal irradiation for India

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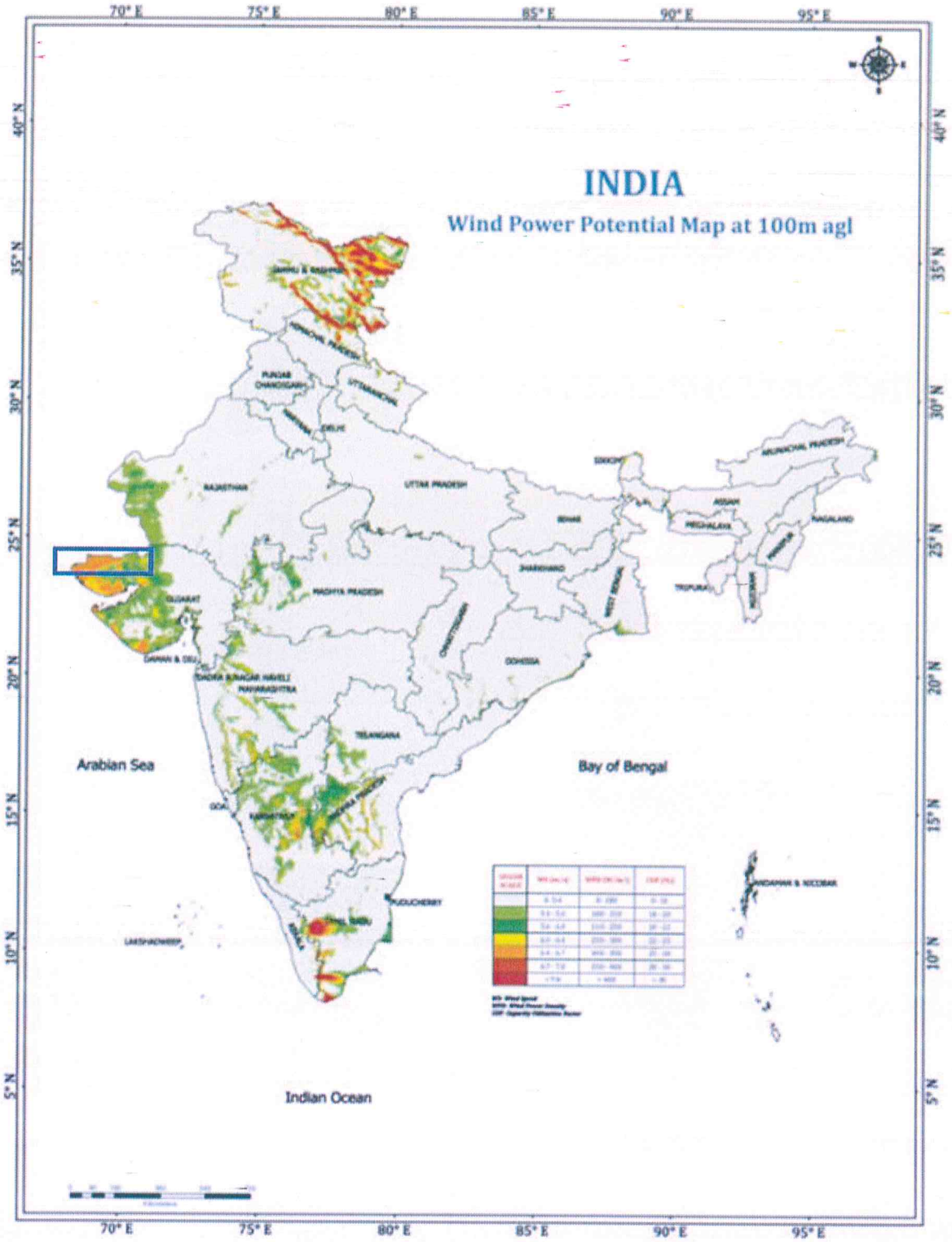

Figure 2: Wind Potential Map for India

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1.1 Company Profile

Headquartered in Ahmedabad, India, Adani Group is one of India's largest integrated infrastructure conglomerates with interests in Resources (coal mining and trading), Logistics (ports, logistics, shipping and rail), Energy (renewable and thermal power generation, transmission and distribution), and Agro (commodities, edible oil, food products, cold storage and grain silos), Real Estate, Public Transport Infrastructure, Consumer Finance and Defence. Adani owes its success and leadership position to its core philosophy of 'Nation Building' and 'Growth with Goodness' - a guiding principle for sustainable growth. The Group is committed to protecting the environment and improving communities through its CSR programme based on the principles of sustainability, diversity and shared values. The group has annual revenue of over **US $23 billion** with six listed entities.

ADANI Group is manned by experienced and highly qualified professionals including technocrats of repute. The team has demonstrated capabilities in conceptualization and implementation of large projects, excellent records of establishing benchmarks in the industry. ADANI Group has rich and extensive experience of liaison with government agencies, import, funding etc. With this track record of the organization in tying up finances, flow of funds will not pose any problem for implementation of the proposed project.

Adani Green Energy Limited (AGEL) is the renewable energy arm of Adani Group. AGEL is India's only listed renewable IPP with approx. 2 GW of operational Solar PV Plants and another 1.5 GW of Solar PV & Wind under construction. AGEL aims to build more than 25,000 MW of Renewable portfolio by 2025 in line with Government of India's objective to reach 175 GW installed renewable capacity by the year 2022.

In order to achieve this objective, AGEL has been carrying out studies to assess the potential at site locations near Khavda Village in Kutch district, Gujarat. Based on due diligence, AGEL foresees huge renewable energy power generation potential in the area and intends to develop world's largest capacity of Wind-Solar Hybrid Power project. It is expected that project of such a large scale shall be developed over a period of time, in phased manner. The project has also been showcased by our honourable Chairman in recently concluded **Vibrant Gujarat Summit-2019.**

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The project execution at such a big scale shall require development of support facilities like manufacturing units, accommodation facilities for manpower, material storage etc. in its vicinity for optimization of project cost in terms of time and money. These facilities shall also act as support base during the operational phase of the project.

The objective of this report is to provide the details for **765 kV Double Circuit Transmission Line from Khavda to Bhuj PSS1 for Proposed 3.5 GW Hybrid (Wind-Solar) Power Park near Rann of Kutch, Khavda Village, Kutch District of Gujarat** indicating the site features, salient technical features, financial and Project schedule for application of diversion or Forest area for non-forest purpose.

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2. PROJECT BACKGOROUND / REQUIREMENT

In accordance with the Gujarat Government policy dated **25th January 2019** for "Allotment of Government waste / barren land for the purpose of raising Renewable Energy Generation Park" Adani Green Energy Limited (AGEL) has proposed to develop 10,000 MW Wind Solar Hybrid Park Project near Khavda Village of Kutch district, Gujarat. The Proposed Wind-Solar Hybrid Park will require an estimated area of approx. 20,000 Ha of land. The entire land identified for the park is barren revenue wasteland.

The proposed Project site is located near Rann of Kutch region of the North Western part of Kutch District, about 100 km North of Bhuj Town and about 25 km North-West of Khavda Village.

Table 1: Details of Project Particulars

Particulars	Project Description
Project Location	Village- Un-surveyed Land near Khavda Taluka – Bhuj District -Kutch State- Gujarat
Nearest Railway Station	Bhuj
Nearest Airport	Bhuj
Nearest Sea Port	Mundra Port, Gujarat
Site Connectivity	Connected to Bhuj via SH 45 and NH 341
Terrain Type	Flat Terrain
Vegetation	Scarcely distributed bushes like Babul
Site NGL (m above MSL)	3 to 5
Site Climatic Zone	Desert and Hot Arid
Hourly Average Temperature Range	8.6°C to 41°C
Annual Average Relative Humidity	41.7% (monthly average relative humidity ranging from 27.27% to 63.5%)
Average Annual Rainfall	376mm
Annual Average Wind Speed at 10 m Height above Ground Level	4.7 m/s
Annual Average Wind Speed at 100 m Height above Ground Level	~7.5 – 8.0 m/s
Water Quality at Site	Scarcity of Sweet Water. Ground Water is highly saline.
Seismic Intensity	Site is located at Seismic Zone – V

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3. LOCATION MAP & KEY PLAN

3.1 Index Map of India & Gujarat State

Figure 3: Map of India & Gujarat State

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3.2 Map of Kutch District of Gujarat State

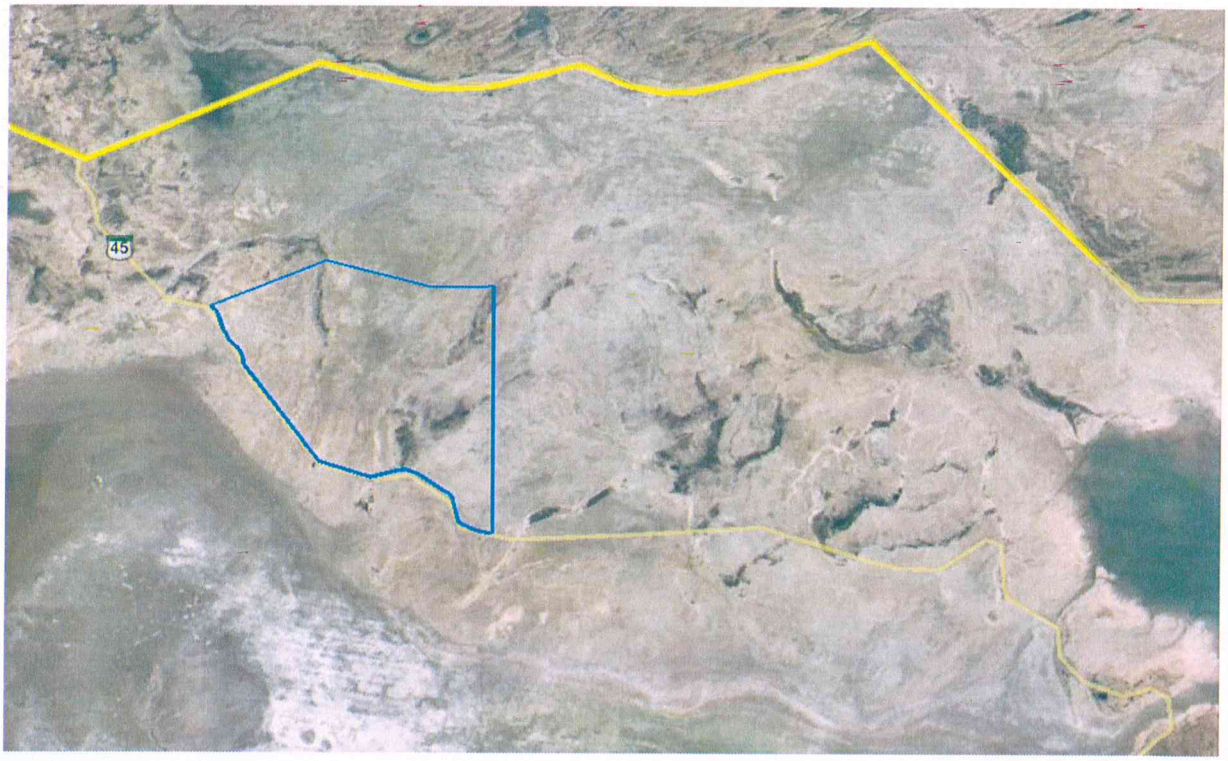

Figure 4: Map of Kutch District in Gujarat State

3.3 Proposed Project Site for Transmission Line– From Khavda – Bhuj PGCIL SS

Figure 5: Proposed Wind-Solar Hybrid Project Location, Khavda Project

4. KEY FEATURES OF THE PROJECT SITE

4.1 Site Location Details:

Project Authority :	Adani Green Energy Thirty Ltd, (AGE30L)
Project Details & its Location	765 kV Double Circuit Transmission Line from Khavda to Bhuj PSS1 of **Approx. 102 km** for Proposed 3.5 GW Hybrid (Wind-Solar) Power Park near Rann of Kutch, Khavda Village, Kutch District of Gujarat

4.2 Employment Generation:

At present the socio-economic conditions of the people in the study area is not good mainly due to low agricultural productivity and absence of alternate livelihood options. The proposed project will have a positive impact on the socioeconomic conditions of the people by providing direct and indirect employment in the proposed project both during construction and operation phases. Also the project shall enhance economic growth of the area in general. During the construction and operation periods, project would have significant requirements for masons, plumbers, electricians, carpenters, fitters, welders, security personnel, other miscellaneous services in canteen, plantation, drivers, housekeeping, etc. During **construction** phase, project would employ around **150 nos. temporary** skilled, semi-skilled and unskilled manpower and around **20 no. permanent** employees. It is envisaged that the project phase will be of **18 (Eighteen) Months**. For **operation** and maintenance of transmission line, AGE30L would employ **10 nos. temporary** skilled, semi-skilled and unskilled manpower and around **08 no. permanent** employees. Operation Stage is envisaged for 30 Years.

4.3 CLIMATE AND METEOROLOGICAL DATA

Dry Bulb Temperature	Max.: 45° C, Min : 10 ° C
Rainfall Annual Average	1317 mm
Type of Land	Revenue / Waste Land
Maximum 24 hour rainfall	307.3 mm
Rainfall (Sahibganj) Annual Average	1576 mm

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5. SITE SELECTION CRITERIA

5.1 765 kV Double Circuit Transmission Line Route

The main factors considered for selection of a suitable site are:

- Availability of adequate land for power plant along with suitability for operational facilities.
- Land Topography, terrain and Geotechnical conditions
- Annual Wind Resource Availability
- Evacuation Infrastructure of power
- Market requirement for power
- Minimal rehabilitation requirement
- Environmental compatibility
- Road Connectivity and access to other infrastructure facilities

Three routes have been evaluated and alternate – 01 is finalized based on lesser requirement of forest diversion.

Table 2: Comparative Statement for Alternative Route Analysis

Sr. No.	Description	Final Route R1	Alternate Route R2	Alternate Route R3
1	Bee Line Length(KM)	78.010	78.010	78.010
2	Line –Length (KM)	102.243	81.298	80.923
a)	Plain	97.771	78.661	78.142
b)	Undulated	-	-	-
c)	Hilly	4.472	2.637	2.781
3	Angle Points (includes start & end point)	34	23	30
4	Gantry	1	1	-
5	Power Line Crossings	Nakhatrana, Khavda, Bhuj	Nakhatrana	Nakhatrana
6	Railway Crossing	0	5	5
7	River Crossing	Nil	Nil	Nil
8	Pollution	Nil	Nil	Nil
10	Special Towers	Nil	Nil	Nil
11	Population Major Cities	Nakhatrana, Khavda, Bhuj	Nakhatrana	Nakhatrana
12	Densely populated Areas	-	Nil	Nil
13	Airports	Nil	Nil	Nil
14	**Forest Length (km)**	**33.778**	**42.979**	**41.707**

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a)	Reserve Forest(km)	0	0	0
b)	Banni Forest (km)	33.778	42.979	41.707
15	**Forest Area (in Ha)**	**226.3223**	**287.95**	**279.44**
16	CRZMA Length (Km)	Nil	16.677	16.527
17	Creek Length (Km)	6.563	5.940	5.530
18	Sanctuary Length (Km)	Nil	Nil	Nil
19	Sanctuary 5km Buffer Length (km)	Nil	Nil	16.104
20	BSF Area (Km)	40.952	12.676	12.898
21	Tree (Density)	Low to Medium	Medium	High
22	NH/SH crossing	0 / 4	0 / 2	0/2
23	Special Foundations	Nil	Nil	Nil
24	Conclusion	Although the route length of this route is longest among all the three alternatives, however, this route is avoiding CRZ hence, this route is best among all the three alternatives and is also feasible from the construction, operation and maintenance point of view. Hence, this route is recommended for route alignment survey.	Although this is the shorter than route no. 1, however, this route is falling in the CRZ area and obtaining permission for working through CRZ area is very time consuming and difficult and hence, this route is not feasible from the construction and O&M point of view, hence, this route is not recommended for route alignment survey.	Although this is the shortest route among all the three alternatives, however, this route is falling in the CRZ area and obtaining permission for working through CRZ area is very time consuming and difficult and hence, this route is not feasible from the construction and O&M point of view, hence, this route is not recommended for route alignment survey.

6. LAND REQUIREMENT

Transmission line corridor width has been envisaged as **67 meter** as per CBIP guidelines & Forest Conservation Rules, 2003 (Guidelines & Clarifications).

Total Land Requirement for the 765 kV Double Circuit transmission line from Khavda to Bhuj PSS1 will be approx. **685 hectare**.

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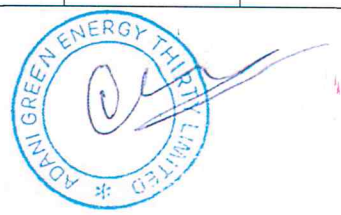
7. LAND AREA STATEMENT

Below table shows the complete Area Statement (Private, Government and Forest land) required for laying the 765 kV Double Circuit Transmission Line Route.

Table 3: Details of Forest & Non-Forest Land Area involved in Proposed 765 KV Transmission line Route

S.L. NO.	VILLAGE NAME	Taluka	Required Forest Land (in Ha)	Required Non-Forest Land (in Ha)	Total Land Requirement (in Ha)	Division	Legal Status (Type of Forest)	Length (in KM)	
								In Forest Land	In Non-Forest Land
1	KUTCH MAP	KUTCH	0.00	275.7580	275.7580	-	-	0.00	41.16
2	DHROBANA	BHUJ	0.00	35.2181	35.2181	-	-	0.00	5.26
3	DINARA	BHUJ	0.00	32.2561	32.2561	-	-	0.00	4.81
4	RATADIYA	BHUJ	0.00	17.6993	17.6993	-	-	0.00	2.64
5	KHAVDA	BHUJ	0.00	11.5909	11.5909	-	-	0.00	1.73
6	LUDIYA	BHUJ	0.00	41.0048	41.0048	-	-	0.00	6.12
7	LAYVARA	BHUJ	46.1106	0.00	46.1106	Banni Grass Land	Protected Forest	6.88	0.00
8	BHIRANDIYARA	BHUJ	127.3332	0.00	127.3332	Banni Grass Land	Protected Forest	19.01	0.00
9	BANNI GRASS LAND	BHUJ	52.8785	0.00	52.8785	Banni Grass Land	Protected Forest	7.89	0.00
10	LORIYA	BHUJ	0.00	11.4827	11.4827	-	-	0.00	1.71
11	ZURA	BHUJ	0.00	31.4033	33.4033	-	-	0.00	4.69
12	BADI PALANPUR	NAKHATRANA	0.00	2.2902	2.2902	-	-	0.00	0.34
Total Area in Hectare			**226.3223**	**458.7034**	**685.0257**	-	-	**33.78**	**68.46**
								102.24	



In the proposed project a total 275 No. of Transmission Towers are envisaged out of which 89 nos. are under forest area.

Table 4: Component Wise Land Area Requirement

S.no	Component	Forest Land (in ha.)	Non-Forest Land (in ha.)	Total Applied Land (in ha.)
1	Transmission Towers Area	4.9611	10.3819	**15.3430**
2	Stringing Area	221.3612	450.1354	**669.6827**
Grand Total		**226.3223**	**458.7034**	**685.0257**

8. PRELIMINARY FEATURES OF ELECTRICAL SYSTEM

Adani Green Energy Thirty Ltd., the user agency, has proposed to construct 765 kV double circuit transmission line from Khavda to Bhuj PSS1. Proposed line is starting from 765 kV Sub-station Near Khavda village and passing through Kutch Dry land, Dhrobana, Dinara, Ratadiya, Khavada, Ludiya, Layvara, Bhirandiyara, Loriya and Zura villages and connecting to 765/400/220 kV PGCIL sub-station at Badi Palanpur.

For the construction of the proposed line, total land requirement is approx. **685 Hectare land**.

- **Narrative of project:** 765 kV D/C Khavda to Bhuj PSS1 Transmission Line.

Sr. no.	Description	Details of project
1.	Voltage of transmission line	765 kV
2.	Total length of transmission line	102.24 km
3.	Width of transmission line	67 meter
4.	Number of towers in transmission line	275 Nos.
5.	Number of towers in Banni Grassland division	89 Nos.
6.	Height of Transmission Line Tower	68 Metre
7.	Ground Clearance of Transmission Line	15 Meter

- **Purpose of the Project:** 765 kV D/C Khavda to Bhuj transmission line is proposed for the transmission of Solar energy generated through the renewable source of energy at Khavda to 765/400/220 kV PGCIL sub-station at Badi Palanpur, Bhuj.

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- **Benefit from the project:** 765 kV D/C Transmission Line from Khavda to Bhuj will connect 765 kV sub-station at Khavda which is renewable source of energy and 765/400/220 kV PGCIL sub-station at Badi Palanpur, Bhuj. This will increase and add-on the total renewable power generation to the national grid.

9. PROJECT COST

Total cost of the project: Total cost for the construction of the project is expected to be **450 Crores.**

10. PROJECT COMPLETION SCHEDULE

Timeline for construction of this project is **18 months** and commencement of transmission of power generated through renewable energy source is proposed on **October 2021.** Operation Life Cycle of project is envisaged for **30 Years.**