

# 2012

## First 50 MW Solar PV Power Project Cholistan Feasibility Study Report



### Volume 5 Environmental Studies: IEE & EIA



&



中水电国际投资有限公司  
CWE INVESTMENT CORPORATION



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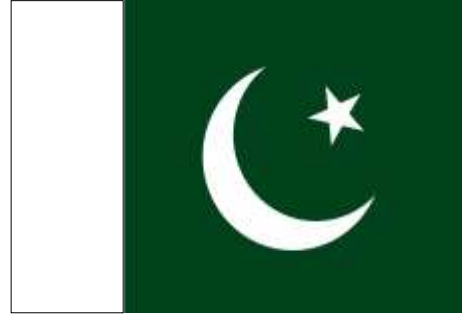
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# **Feasibility Study Report First 50 MW Solar PV Power Project In Cholistan, Punjab, Pakistan**

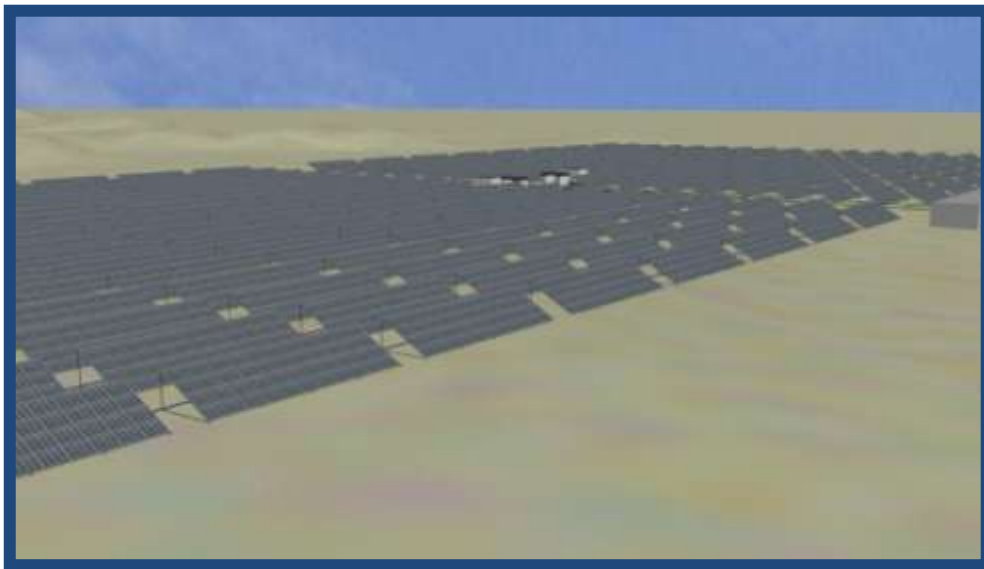
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September, 2012

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## **Volume 5 Environmental Studies: IEE & EIA**

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CHINA WATER AND ELECTRIC INVESTMENT CORPORATION  
&  
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	<b>Feasibility Study Report – Vol 5</b> <b>Environmental Studies</b> <b>50 MW Solar Power Project in Cholistan</b>	Document No. 01-0786-01 Rev No. / Date - Issue No. / Date 02 <sup>nd</sup> June 2012 Effective Date 10 <sup>th</sup> September 2012 Page No. 3 of 81 Originally Prepared by: MR Consultants & CEEG
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## APPROVAL SHEET

**TITLE** : Feasibility Report  
50 MW Solar Power Project in Cholistan

**DOCUMENT NUMBER** : 01-0786-01

**CLASSIFICATION** : Un-Classified

### SYNOPSIS

This document is a feasibility study report of 50 MW Solar PV Power Project sponsored by China Three Gorges International Corp. and Welt Konnect (Pvt) Ltd. It is divided into 7 Volumes volumes for ease of review and approvals.

- Volume 1: Main Report Part 1: of this report contains detailed information regarding the geographic features of Pakistan, along with the insight to Pakistan's Energy and Electricity market. After discussing the solar energy industry and carbon credit details for information purposes, the volume focuses on mentioning the regulatory regime of the country that is applicable to the project and all legal requirements. The volume also summarizes the salient features of the project.
- Volume 2: Main Report Part 2: of the report focuses entirely on the specific details of the project. It provides information on the selected site, the description of the technical equipment and the layout of plant. The report further includes the basis for calculations and designing, by giving details of the grid connections available and yield of power. Prior to conclusion, the report also gives details of the policies and procedures for O&M, Project Management, and tariff calculation. The report concludes with details of the ecological and socio-economic benefits of the project.
- Volume 3: Geo-Technical Study Topographic Survey: of the Project Site, with detailed analysis.
- Volume 4: Geo-Technical Investigation Report: for the Project Site, including Soil Testing

	<p align="center"><b>Feasibility Study Report – Vol 5</b>  <b>Environmental Studies</b>  <b>50 MW Solar Power Project in Cholistan</b></p>	<p><b>Document No.</b> 01-0786-01  <b>Rev No. / Date</b> -  <b>Issue No. / Date</b> 02<sup>nd</sup> June 2012  <b>Effective Date</b> 10<sup>th</sup> September 2012  <b>Page No.</b> 4 of 81  <small>Originally Prepared by: MR Consultants &amp; CEEG</small></p>
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**Volume 5: Environmental Study:** contains the Initial Environmental Examination Report (IEE), the Environmental Impact Assessment Report (EIA), and the No Objection Certificate (NOC) for the project issued by the Environmental Protection Agency (EPA) of Punjab.

**Volume 6:** Clean Development Mechanism: is composed of the Project Idea Note (PIN's), the Letter of Intent (LOI) issued by the Designated National Authority (DNA) the Clean Development Mechanism Cell of Pakistan, Ministry of Climate Change, followed by the Prior Consideration form, the Project Design Document (PDD's) and the Host Country Approval (HCA) by the DNA.

**Volume 7:** Grid Interconnection Study being developed by National Transmission Dispatch Company (NTDC) and to be submitted separately.

**DATE:** 10<sup>th</sup> September 2012

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### **Revisions**

S #	REV. #	DATE	VOL #	SECTION	DESCRIPTION OF CHANGE

### **DISTRIBUTION**

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## LIST OF ABBREVIATIONS

<b>AC</b>	Alternate Current
<b>AEDB</b>	Alternative Energy Development Board
<b>Approx.</b>	Approximately
<b>ASL</b>	Associated Surveyors (Pvt)Ltd
<b>BM</b>	Build Margin
<b>BOO</b>	Build Own and Operate
<b>BOR</b>	Board of Revenue
<b>Bwp</b>	Bahawalpur
<b>CAA</b>	Civil Aviation Authority
<b>CCGT</b>	Combined Cycle Gas Turbine
<b>CDA</b>	Cholistan Development Authority
<b>CDM</b>	Clean Development Mechanism
<b>CDMA</b>	Code division multiple access
<b>CERs</b>	Certified Emission Reductions
<b>CEEG</b>	China Electric Equipment Group
<b>CEEG SI</b>	CEEG Solar Energy Research Institute Co, Ltd
<b>CM</b>	Combined Margin
<b>CMA</b>	Certified Management Accountant

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<b>CNG</b>	Compressed natural Gas
<b>CO2</b>	Carbon dioxide
<b>COD</b>	Commercial Operational Date
<b>CoP</b>	Conference of the Parties
<b>CPPA</b>	Central Power Purchasing Agency
<b>CPV</b>	Concentrator photovoltaic
<b>CTG</b>	China Three Gorges
<b>CTGC</b>	China Three Gorges Corporation
<b>CTGI</b>	China Three Gorges International Corp.
<b>CTGPC</b>	China Three Gorges Project Company
<b>CWE</b>	China Water and Electric Corporation
<b>CWEIC</b>	China Water and Electric Investment Corporation
<b>CYP</b>	China Yangtze Power Co. Ltd
<b>DC</b>	Direct Current
<b>deg</b>	Degree
<b>DG</b>	Diesel Generator
<b>DGP</b>	Dual Global Positioning System
<b>DISCOs</b>	Distribution Companies
<b>DNA</b>	Designated National Authority

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<b>DOE</b>	Designated Operational Entity
<b>DSSC</b>	Dye-Sensitized Solar Cells
<b>EE</b>	Energy Efficiency
<b>EF<sub>y</sub></b>	Baseline Emission Factor
<b>EIA</b>	Environmental Impact Analysis
<b>EMC</b>	Electromagnetic Compatibility
<b>EMP</b>	Environment Plan
<b>EPA</b>	Energy Purchase Agreement
<b>EPC</b>	Engineering Procurement Construction
<b>EPIA</b>	European Photovoltaic Industry Association
<b>EU</b>	European Union
<b>FDI</b>	Foreign Direct Investment
<b>FSR</b>	Feasibility Study Report
<b>GDP</b>	Gross Domestic Product
<b>GENCOs</b>	Generation Companies
<b>GHG</b>	Green Gas
<b>GIS</b>	Geographic Information System
<b>GoP</b>	Government of Pakistan
<b>GPS</b>	Global Positioning System

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<b>GSM</b>	Global System for Mobile Communications
<b>GTZ/GIZ</b>	Deutsche Gesellschaft für Technische Zusammenarbeit
<b>HCA</b>	Host Country Approval
<b>HFCs</b>	Hydro Fluorocarbons
<b>HOMER</b>	Hybrid Optimization Model for Electric Renewables
<b>HSE</b>	Health Safety and Environment
<b>HSHD</b>	Hard Surface High Duty
<b>Hz</b>	Hertz
<b>IA</b>	Implementation Agreement
<b>IDC</b>	Interest During Construction
<b>IEA</b>	International Energy Agency
<b>IEE</b>	Initial Environmental Examination
<b>IEEE</b>	Institute of Electrical and Electronic Engineers
<b>IFC</b>	International Finance Cooperation
<b>IPPs</b>	Independent Power Producers
<b>IRR</b>	Internal Rate of Return
<b>JEDI</b>	Jobs and Economic Development Impact
<b>JI</b>	Joint Implementation
<b>JRC</b>	European Joint Research Centre

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<b>Km</b>	Kilometer
<b>KV</b>	Kilovolt
<b>KW</b>	Kilowatt
<b>LIBOR</b>	London Interbank Offered Rate
<b>LNG</b>	Liquefied Natural Gas
<b>LNG</b>	Liquefied Natural Gas
<b>LOI</b>	Letter of Intent
<b>LOS</b>	Letter of Support
<b>LPG</b>	Liquefied Petroleum Gas
<b>LUC</b>	Local Control Unit
<b>m<sup>2</sup></b>	Meter Square
<b>m<sup>3</sup>/h</b>	Meter cube per hour
<b>MEPCO</b>	Multan Electric Power Company
<b>mm</b>	Millimeters
<b>mmcft</b>	Million Cubic Feet
<b>MoU</b>	Memorandum of Understanding
<b>MTDF</b>	Medium Term Development Framework
<b>MVA</b>	Million Volt-Ampere
<b>MW</b>	Megawatt

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<b>N<sub>2</sub>O</b>	Nitrous Oxide
<b>NAPWD</b>	Northern Area Public Works Department
<b>NASA</b>	National Aeronautics and Space Administration
<b>NCS</b>	National Conservation Strategy
<b>NEC</b>	National Energy Conservation
<b>NEPRA</b>	National Electricity Power Regulatory Authority
<b>NEQs</b>	National Environmental Quality Standards
<b>NGOs</b>	Non-Government Organizations
<b>NOCs</b>	No Objection Certificate
<b>NOCT</b>	Nominal Operating Cell Temperature
<b>NREL</b>	National Renewable Energy Laboratories
<b>NTDC</b>	National Transmission and Dispatch Company
<b>O &amp; M</b>	Operation & Management
<b>OECD</b>	Organization for Economic Cooperation and Development
<b>OEMs</b>	Original Equipment Manufacturer
<b>OHL</b>	Overhead Lines
<b>OLTC</b>	On-Load Tap Changer
<b>OM</b>	Operating Margin
<b>OPV</b>	Organic photovoltaic

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<b>OSHA</b>	Occupational Safety and Health Administration
<b>PAEC</b>	Pakistan Atomic Energy Commission
<b>PAEC</b>	Pakistan Atomic Energy Commission
<b>PCM</b>	Pulse Code Modulation
<b>PCRET</b>	Pakistan Council of Renewable Energy and technology
<b>PDD</b>	Project Design Document
<b>PEPA</b>	Pakistan Environment Protection Act
<b>PINs</b>	Project Idea Note
<b>PLC</b>	Programmable Logic Control
<b>PMD</b>	Pakistan Meteorological Department
<b>POE</b>	Panel of Experts
<b>PPDB</b>	Punjab Power Development Board
<b>PPIB</b>	Private Power Infrastructure Board
<b>PV</b>	Photo Voltaic
<b>PVC</b>	Poly Vinyl Carbonate
<b>QC</b>	Quality Control
<b>R &amp; D</b>	Research and Development
<b>RE</b>	Renewable Energy
<b>RE2</b>	Renewable Resources (Pvt) Ltd

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<b>RFP</b>	Request for Proposal
<b>RFQ</b>	Request for Quotation
<b>RMP</b>	Risk Management of Project
<b>ROC</b>	Return on Capital
<b>ROE</b>	Return on Equity
<b>RQD</b>	Rock Quality Designation
<b>SECP</b>	Security Exchange of Pakistan
<b>SHYDO</b>	Sarhad Hydro Development Organization
<b>SOP</b>	Standard Operating Procedure
<b>SPT</b>	Standard Penetration Test
<b>SRA</b>	Solar Resource Assessment
<b>SRO</b>	Statutory Regulatory Order
<b>TGP</b>	Three Gorges Project
<b>TOE</b>	Tons Oil Equivalent
<b>tsf</b>	Tones/square foot
<b>TTG</b>	Trans Tech Group
<b>TTP</b>	Trans Tech Pakistan
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UPS</b>	Uninterruptible Power Supply

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<b>USA</b>	United States of America
<b>WAPDA</b>	Water & Power Development Authority
<b>WK</b>	Welt Konnect (Pvt) Ltd
<b>WMO</b>	World Metrological Organization

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The management of CWE Investment Corporation a fully owned subsidiary of China Three Gorges International Corporation & Welt Konnect (Pvt) Ltd comprising the Joint Venture would like to express their gratitude to the support and cooperation extended by the Government of Punjab in the development activities of the project.

We are also thankful to the dedicated team of the Punjab Power Development Board (PPDB) for the generous support throughout all stages of project development.

We hope for and look forward to the continued cooperation of all relevant Government Organizations, Bodies and officials for further advancement in implementing the Project and pioneering the way for Solar Photo Voltaic in Pakistan.

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## CONSULTANT CONTACT INFORMATION

Consultant	CEEG Solar Energy Research Institute Co, Ltd (CEEG SI)
Address	No 6, Shuige Road, Jiangning Development Zone, Nanjing, CHINA 211153
Telephone	+86 25 5209 5704
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Website	<a href="http://www.ceeg.cn">www.ceeg.cn</a>
Contact Person	Ms. Violet Rong
Email	<a href="mailto:violet@ceeg.cn">violet@ceeg.cn</a>

Consultant	M.R. Consultants
Address	Flat No-1, Zafar Plaza, Khurshid Market, F10/1 Islamabad
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Fax	051-2211568
Website	-
Contact Person	MAJ (Retd.) Riaz Ul Hassan
Email	<a href="mailto:mrconsult@hotmail.com">mrconsult@hotmail.com</a>
Contact Person	Mr. Kashif Riaz
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## DOCUMENT INFORMATION

### Purpose and Scope:

The purpose of this report is to provide information required for the relevant agencies to make informed decision regarding the implementation and execution of this project.

This document presents the technical, financial and commercial viability of this project within Pakistan's economic and regulatory framework.

## STRUCTURE OF THE DOCUMENT:

The Feasibility Study has been divided into 2 main parts/volumes followed by supporting Volumes 3 to 7 composed of essential studies:

- ❖ Volume 1: is composed of the Executive Summary, Introduction and Overview of the Project along with the relevant regulatory framework and policies. Where as
- ❖ Volume 2: contains the Technical and Financial Studies: including Engineering Drawings and Plant 3D layout.
- ❖ Volume 3: is composed of the Geo-Technical Study Topographic Survey.
- ❖ Volume 4: is the Geo-Technical Investigation Report.
- ❖ **Volume 5: is a compiled Environmental Study.**
- ❖ Volume 6: contains all documents relevant to the Clean Development Mechanism of the UNFCCC.
- ❖ Volume 7: is the Grid Interconnection Study being developed by the National Transmission Dispatch Company (NTDC) and to be submitted separately.

Each Volume is further sub-divided into chapters for ease of reviewing and understanding the project. Information in the document is supplemented by Annexures attached at the end of each volume.

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## EXECUTIVE SUMMARY OF THE PROJECT

China Three Gorges (CTG) being a large international clean energy company, houses main businesses of including construction and management of water conservancy projects, electric power production and related relevant technological services. In the area of electric power production, CTG, initially starting with water conservancy & power projects, has now expanded its scope of business into Power Production through Wind, Solar and Nuclear Energy. Their vision is to be the World's largest clean energy group specializing in large-scale hydropower project development, management and operations; while also proactively developing Wind Power, Solar Power and other forms of renewable energy; steadily expanding and exploring avenues of overseas business.

The Total assets of the Group stand around 41,316 million USD, with a revenue generation of 3,787 million USD, 99.47% from sales of electricity, and 1,418 million USD net profits.

Whereas China Water and Electric Investment Corp. (CTGI) *is a new overseas-investment subsidiary company of CTG*, which was established in Sep. 2011 with the core business and focus on OVERSEAS INVESTMENT in the Power Sector including but not limited to hydropower, wind power and solar power. CWE Investment Corporation (CWEIC) has now officially taken over as main sponsor from China Water and Electric Corporation (CWE) in all projects previously being developed by CWE. CWEIC is tracing on more than a dozen projects located in Asia, Africa, Europe, North America and South America. Some of the projects located in Pakistan include Sonda Jehrruk Coal Mine & Power Generation, 1100 MW Kohala Hydropower Project, 720 MW Karot Hydropower Project, 120MW Taunsa Hydro Power Project, 50MW Wind Energy and First 50 MW Solar PV Power Project in Pakistan.

Whereas Welt Konnect (Pvt) Ltd (a subsidiary of the Transtech Group) is a Power Projects Developing company working in Pakistan. Its niche in the Energy Sector lies in the provision of Renewable Energy Engineering solutions particularly for Wind & Solar Power Projects as Independent Power Producers (IPP's) under the Clean Development Mechanism of the UNFCCC. These integrated solutions and systems are designed, simulated and tested by its team of experts and engineers' using the most advanced software's and tools the industry has to offer at this time. WK believes in doing top quality engineering works and takes immense pride in being one of the few companies in Pakistan to have achieved this level of competence in the ever growing and critical field of Renewable Energy.

In Accordance with their development strategies respectively, in 2009 after consultation with the Esteemed Punjab Government Welt Konnect (Pvt) Ltd (WK) and China Three Gorges (CTG), planned to invest in the development & construction of Pakistan's first 50 MW Solar PV Power Farm in Cholistan in collaboration as a

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Joint Venture. For development of which consequently two MOU's were signed with the Punjab Government in the presence of the Honorable Chief Minister Mr. Shahbaz Sharif, dated June 5<sup>th</sup> 2010 and later November 6<sup>th</sup> 2010 after having chalked out a way forward. An MOU was also signed with GTZ for support in developing the project under the Clean Development Mechanism of the UNFCCC.

The Project Site is located near the Cholistan Desert, District Bhawalnagar, with nearest city of Bahawalpur and will have an installed capacity of 50MWp Photovoltaic Panels and will function as an Independent Power Producer (IPP) under the rules and regulations of Pakistan.

The project pre-feasibility study was completed by mid-2011. Subsequently after submission of the Pre-Qualification Documents, to the Punjab Power Development Board (PPDB) along with the Pre-Feasibility Report, Project Proposal, the required Bank Guarantees of 50'000.USD (fifty thousand) and the requisite fees, the Joint Venture (JV) successfully obtained an LOI (Letter of Intent) from the Board duly signed and accepted by both parties on 27-08-2011, along with Government Approvals and Support.

Teams were then immediately deployed to initiate work on the feasibility analysis of the project, and competent teams of Engineers & Specialists were deployed for conducting the Environmental Studies, which have successfully been completed and compiled in this Volume 5 of the Feasibility Study.

There are no environmental hazards related to the Project. The minor adjustments required during construction phase have been addressed and mitigation plan provided. There are no settlements within 05-08 Km of the Project Site, which further supports the Project in this location. Although the 50 MW Cholistan Solar PV Power project is exempted from all requirements of IEE and EIA as it falls under the schedule II classified by Pakistan Environmental Protection Agency regulations 2000, S.R.O 339(1)/2001, on advice of the Ministry of Climate Change vide its CDM Cell, both studies were conducted and submission made to EPA Punjab which after its due diligence has issued a No Objection Certificate (NOC)/Environmental Approval to the Project dated 13/09/2012.

The Joint Venture is now submitting the final Feasibility Study along with this Volume 5, for approval by the Panel of Experts (POE) of the Punjab Power Development Board (PPDB). After sanctioning of which competent companies in the field of Solar Photovoltaic's will be selected through a Short Listing Criteria based on Experience, Financial And Technical Competencies of such firms in development & construction of Power Projects and Project Management, which shall be advertised in the News Papers & other relevant media. Consequently the Request for Proposal (RFP) shall be circulated and shared amongst the qualifying companies for finalization of the Engineering Procurement & Construction (EPC) Contract after which a petition for Generation License and a petition for tariff would

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simultaneously be filed with the National Electric Power Regulatory Authority (NEPRA) directly for the second stage tariff as allowed under their policy, before issuance of the LOS (Letter Of support) by PPDB. This is intended to save time and cut through avoidable red tape in the development of Independent Power Producers in Pakistan.

The Joint Venture has also completed substantial work on the financial modeling for the project. The JV believes that keeping in view the recent improvement and trend in the viability of the technology, possibility of fast track implementation and current energy crises, this project is of paramount importance for Pakistan and will prove to be a pioneer in the Solar PV industry, paving the way for future progress in this ever growing field and at the same time provide a viable profitable investment opportunity to all stake holders of the country.

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## 1 INTRODUCTION AND ENVIRONMENTAL APPROVAL FOR THE PROJECT

One of the most important feature of solar PV systems is that there are no emissions of carbon dioxide - the main gas responsible for global climate change - during their operation. Although indirect emissions of CO<sub>2</sub> occur at other stages of the lifecycle, these are significantly lower than the avoided emissions. PV does not involve any other polluting emissions or the type of environmental safety concerns associated with conventional generation technologies. There is no pollution in the form of exhaust fumes or noise.

Decommissioning a system is unproblematic. Although there are no CO<sub>2</sub> emissions during operation, a small amount does result from the production stage. PV only emits 21.65 grams CO<sub>2</sub>/kWh, however, depending on the PV technology. The average emissions for thermal power, on the other hand, are 900g CO<sub>2</sub>/kWh. By substituting PV for thermal power, a saving of 835879 g/kWh is achieved.

The benefit to be obtained from carbon dioxide reductions in a country's energy mix is dependent on which other generation method, or energy use, solar power is replacing. Where off-grid systems replace diesel generators, they will achieve CO<sub>2</sub> savings of about 1 kg per kilowatt-hour. Due to their tremendous inefficiency, the replacement of a kerosene lamp will lead to even larger savings, of up to 350 kg per year from a single 40 Wp module, equal to 25kg CO<sub>2</sub>/kWh. For consumer applications and remote industrial markets, on the other hand, it is very difficult to identify exact CO<sub>2</sub> savings per kilowatt-hour.

Recycling of PV modules is possible and raw materials can be reused. As a result, the energy input associated with PV will be further reduced. If governments adopt a wider use of PV in their national energy generation, solar power can therefore make a substantial contribution towards international commitments to reduce emissions of greenhouse gases and their contribution to climate change. Natural gas is the most environmentally sound of the fossil fuels, because it produces roughly half as much carbon dioxide as coal, and less of other polluting gases. Nuclear power produces very little CO<sub>2</sub>, but has other major safety, security, proliferation and pollution problems associated with its operation and waste products.

### Exemption from EIA or IEE

In addition virtue of the appropriate research, concrete reasons and paperwork, Please be informed that the matter of IEE and EIA reports for the 50MW Solar PV Power Project, was taken up with the Federal Government Ministry of Water and Power, with respect to the Exemption of the said Solar Power Project from either of EIA And IEE Studies, under the Pakistan Environmental Protection Act, 1997 (which

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primarily deals with the creation of EPA's and their ambit of functioning with general guidelines) and the PAKISTAN ENVIRONMENTAL PROTECTION AGENCY (REVIEW OF IEE AND EIA) REGULATIONS, 2000 (the only document dealing in detail with IEE and EIA Studies.), ***As a result of which we a conditional No Object Certificate (NOC) has already been issued and is below.***

You will find below a more detailed explanation to the above synopsis.

As can be seen in the language of article 12 of the Pakistan Environmental Protection Act, 1997, provided below and its relevant portion quoted here:

**"No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, *as the case may be*, or, *where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof.*"**

the proponent is Not required to do the IEE or EIA if that is not required as the case may be and/or the project does not have an adverse effect on the Environment. We are very well aware that Solar Power Project particularly Photovoltaic's has no such effect.

Now coming to the PAKISTAN ENVIRONMENTAL PROTECTION AGENCY (REVIEW OF IEE AND EIA) REGULATIONS, 2000 whose relevant sections 3. **Projects requiring an IEE**, 4 . **Projects requiring an EIA** and 5 **Projects not requiring an IEE or EIA**, are provided below. It can clearly be seen that We neither fall in Schedule 1 or Schedule II of the Regulations Governing the functioning of the EPA's with respect to the IEE and EIA reports.

### **3. Projects requiring an IEE**

A proponent of a project falling in any category listed in Schedule I shall file an IEE with the Federal Agency, and the provisions of section 12 shall apply to such project.

### **4. Projects requiring an EIA**

A proponent of a project falling in any category listed in Schedule II shall file an EIA with the Federal Agency, and the provisions of section 12 shall apply to such project.

### **5. Projects not requiring an IEE or EIA**

(1) A proponent of a project not falling in any category listed in Schedules I and II shall not be required to file an IEE or EIA:

Provided that the proponent shall file –

(a) an EIA, if the project is likely to cause an adverse environmental effect;

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(b) for projects not listed in Schedules I and II in respect of which the Federal Agency has issued guidelines for construction and operation, an application for approval accompanied by an undertaking and an affidavit that the aforesaid guidelines shall be fully complied with.

(2) Notwithstanding anything contained in sub-regulation (1), the Federal Agency may direct the proponent of a project, whether or not listed in Schedule I or II, to file an IEE or EIA, for reasons to be recorded in such direction: Provided that no such direction shall be issued without the recommendation in writing of the Environmental Assessment Advisory Committee constituted under Regulation 23.

(3) The provisions of section 12 shall apply to a project in respect of which an IEE or EIA is filed under sub-regulation (1) or (2)."

12. Initial environmental examination and environmental impact assessment.—(1) No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof.

(2) The Government Agency shall subject to standards fixed by the Federal Environmental Protection Agency—

(a) review the initial environmental examination and accord its approval, or require submission of an environmental impact assessment by the proponent; or

(b) review the environmental impact assessment and accord its approval subject to such conditions as it may deem fit to impose, require that the environmental impact assessment be re-submitted after such modifications as may be stipulated or reject the project as being contrary to environmental objectives.

(3) Every review of an environmental impact assessment shall be carried out with public participation and no information will be disclosed during the course of such public participation which relates to—

(i) trade, manufacturing or business activities, processes or techniques of a proprietary nature, or financial, commercial, scientific or technical matters which the proponent has requested should remain confidential, unless for reasons to be recorded in writing, the Director General of the Federal Agency is of the opinion that the request for confidentiality is not well- founded or the public interest in the disclosure outweighs the possible prejudice to the competitive position of the project or its proponent; or

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(ii) international relations, national security or maintenance of law and order, except with the consent of the Federal Government; or  
(iii) matters covered by legal professional privilege.

(4) The Government Agency shall communicate its approval or otherwise within a period of four months from the date the initial environmental examination or environmental impact assessment is filed complete in all respects in accordance with the prescribed procedure, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations.

(5) Subject to sub-section (4) the appropriate Government may in a particular case extend the aforementioned period of four months if the nature of the project so warrants.

(6) The provisions of sub-sections (1), (2), (3), (4) and (5) shall apply to such categories of projects and in such manner as may be prescribed.

(7) The Government Agency shall maintain separate registers for initial environmental examination and environmental impact assessment projects, which shall contain brief particulars of each project and a summary of decisions taken thereon, and which shall be open to inspection by the public at all reasonable hours and the disclosure of information in such registers shall be subject to the restrictions specified in sub-section (3)."

Hence the project is exempt from the IEE and EIA studies and an NOC in this regard has already been issued.

#### **Initial Environment Examination (IEE) and Environmental Impact Assessment (EIA)**

However on advise of the Clean Development Mechanism Cell Ministry of Climate Change, both the IEE and EIA studies were conducted and the relevant No Object Certificate obtained by the Environmental Protection Agency (EPA) of Punjab on 13/09/2012 provided below. The IEE and EIA are provided below in Section 2 and 3 respectively late in the booklet.

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FROM : EPA, PUNJAB, C. FAX NO. : 8429232225 Jan. 01 1999 06:55AM P1

**ENVIRONMENT PROTECTION DEPARTMENT**  
Government of the Punjab  
NATIONAL HOUSING AND CONSTRUCTION AUTHORITY, LAHORE  
NO. 12 (EIA) EPA/F-362(IEE)/2012/ 544/0309  
Dated: 13/09/2012

To: Mr. Faiz Ahmad,  
Managing Director,  
M/s Well Kenned Pvt. Ltd.,  
Suit 08, Ground Floor, Evance Trust Complex,  
F-5/1, Islamabad.

Subject: **ENVIRONMENTAL APPROVAL**  
(Under Section 12 of the PEP Act, 1997 (amended in 2012) read with IEE/EIA Regulations, 2000)

1. Description of Project: Installation of Solar PV Power Project with capacity of 50MW over an area of 300 Acres.

2. Location of Project: Project is located in Chak No. 314A, Block 3,4,23, Bahawalpur, District Cholistan, Punjab.

3. Date of receiving of case: 27.04.2012.

4. After review of the Initial Environmental Examination (IEE) Report, SIR by DOE and other relevant report, the Environmental Protection Agency, Punjab accord approval for construction phase of the above-mentioned project to safeguard the environmental issues subject to the following conditions:

- The proponent shall ensure compliance of National Environmental Quality Standards (NEQS).
- Mitigation measures suggested in the IEE Report and Environmental Management Plan (EMP) shall be strictly adhered to minimize any negative impacts on soil, ground water, air and biological resources of the project area.
- Monitoring shall be carried out during the entire period of the project activities. Monitoring reports of the whole operation shall be submitted to EPA, Punjab on quarterly basis.
- Camping sites shall be located at suitable distance away from any settlement to avoid disturbance to the local people. Sewage generated from camping sites shall be treated in septic tanks and sink pits.
- The proponent shall install proper equipment for dust collection.
- Hazard of soil erosion will be minimized with proper provision for resurfacing of exposed areas.
- The area around the project site shall be kept clean.
- The proponent shall dispose of solid waste in a proper scientific way in consultation with TMA/District Government.
- The proponent shall ensure efficient health and first aid treatment facilities for protection of workers.
- The proponent shall plant indigenous species of trees around the project area on available space within six months and shall do proper landscaping after completion of the project.
- The proponent shall provide copy of Map/drawing of the project after approval from the competent authority and copies of other NOCs also.
- The proponent shall avoid the disturbance of the traffic flow due to heavy traffic during construction and operation phases.
- The construction material shall be piled / stored in such a way that it shall not destroy the flora / environment of the locality.
- The proponent shall care about noise issues during construction and operation stage of the project.
- The objections/complaints of the locals/stakeholders (if any) shall be redressed on priority basis.

P.T.O

Figure 1.1: NOC by EPA Punjab Part 1

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T : EPA, PUNJAB, ( FAX NO. : 0429232228 Jan. 01'1999 06:55AM P2

xvi. The proponent shall provide compensation to the inhabitants in case of loss of agricultural land, crop, property, etc. in accordance with the rates that are agreed upon. All conflicting issues regarding compensation, etc. shall be settled amicably before the start of the project activities.

xvii. The proponent shall ensure safety of the surrounding buildings, community and workers during construction of the project.

xviii. The proponent shall obtain NOC / clearance from all other concerned departments before commencement of work.

xix. The proponent shall appoint Environmental Manager for the project and shall convey his name along with his complete Mailing Address and Phone Numbers.

5. The Proponent shall be liable for correctness and validity of the information supplied by the environmental consultant.


6. The Proponent shall be liable for compliance of regulations 13, 14, 17 and 18 of IEE/EIA Regulations, 2000, regarding approval, confirmation of compliance, entry, inspections and monitoring.

7. This approval is accorded only for the construction phase of the project. The proponent will obtain approval for operational phase of the project in accordance with regulation 13(2)(b) and regulation 18 of the IEE/EIA Regulations, 2000.

8. Any change in the approved project shall be communicated to EPA, Punjab and shall be commenced after obtaining the approval.

09. This approval shall be valid (for commencement of construction) for a period of three years from the date of issue under regulation 16 of IEE / EIA Regulations, 2000.

10. This approval can be withdrawn at anytime without any prior notice if deem necessary in the public / national interest.

  
(RIAZ AHMED)  
ASSISTANT DIRECTOR (EIA)  
for Director General, EPA, Punjab  
Ph: # (042)99232228

NO. & DATE EVEN

A copy is forwarded for information to:

1. The Director (P&C), Environmental Protection Agency, Punjab.
2. The District Officer (Environment), Bahawalpur w.r.t. his letter No. 13460/TIA/DQE/BWP dated 18.07.2012. He is directed to ensure compliance of the above conditions under intimation to this office.


  
(RIAZ AHMED)  
ASSISTANT DIRECTOR (EIA)  
for Director General, EPA, Punjab

Figure 1.2: NOC by EPA Punjab Part 2

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**Government of Pakistan**  
**Ministry of Water and Power**  
**National Energy Conservation Centre (ENERCON)**


ENC/MoWP/MD-1(11)/2011  
Dated: 31-10-2011

To:

Mr. Habib Ahmed Khan,  
Director Operations,  
WELT KONNECT (Pvt) Ltd  
Sult 8, Ground Floor,  
Evacuee Trust Complex, F-5/1,  
Islamabad

Subject: CONDITIONAL ENVIRONMENTAL APPROVAL

Reference your letter dated 26<sup>th</sup> October, 2011

a. Description of the Project Cholistan 50 MW Solar PV grid connected project. Installation of photovoltaic project, in phases of 5 MW. The reduction in emission are estimated to be approximately 50,305 tons CO<sub>2</sub> eq/year

b. Location of the Project Chak No. 314A Bhawalpur, Cholistan, Punjab, Pakistan.

c. Date of Submission 26<sup>th</sup> October, 2011

2. Although the project does not qualify to be categorized under any of the Pak-EPA's "Environmental Assessment" schedule I or II requiring the appropriate respective Environmental Assessment or analysis. However, the proponent is required to observe the following conditions against which the subject conditional approval is granted:

i). The proponent shall ensure full compliance of National Environmental Quality Standards (NEQS).

ii). Regular monitoring report will be submitted to ENERCON during the entire project to observe both efficiency safety and security parameters.

iii). The proponent would ensure a fool proof health protection measures for the users and personnel involved in the operations at all levels.

  
(Faridullah Khan)  
Managing Director ENERCON

ENERCON Building, G-5/2, Islamabad  
Website : www.enercon.gov.pk

Figure 1.3: Conditional NOC by Ministry of Water and Power Enercon

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## 2 INITIAL ENVIRONMENT EXAMINATION (IEE)

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# I. Application Form (As per Schedule IV in PEPPA 2000)

1	Name and Address of Proponent		Phones: Fax: Telex:	
2	Description of Project			
3	Location of Project			
4	Objectives of Project			
5	IEE/EIA attached?	IEE / EIA: <u>Yes</u> /No:		
6	Have alternatives been considered and reported in IEE or EIA	<u>Yes</u> / No		
7	Existing Land Use		Land Requirement	
8	Is the basic Site data available or has it been measured?	(only tick yes if the data is reported in the IEE/EIA)  Meteorology (including rainfall) Ambient Air Quality Ambient Water Quality Ground Water Quality	<u>Available</u>  <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No	<u>Measured</u>  <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No
9	Have estimates of the following been reported?	Water Balance Solid Waste Liquid Waste treatment	<u>Estimated</u> <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No	<u>Reported</u> Yes/ <u>Not Applicable</u> Yes/ <u>Not Applicable</u> Yes/ <u>Not Applicable</u>
10	Source of Power		Power Requirement	
11	Labor Force (number)	Construction: Operation:		

## Verification

I do solemnly affirm and declare that the information given above and contained in the attached IEE/EIA is true and correct to the best of my knowledge and belief.

Date \_\_\_\_\_

\_\_\_\_\_  
Signature, name and designation  
of proponent (with official  
stamp/seal)

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## II. Policy Legal and Administrative Framework

As per the general criteria the project should be consistent with the national laws and sustainable development policies, strategies and plans including:

- **Pakistan Environmental Protection Act- 1997**

The project is in compliance with the PEPA 1997, and as mentioned in Para 12 of the said act, this project being a solar PV project in a desert with almost no population or wildlife or plantation, does not have any adverse effect on the environment whatsoever. However an Environment studies have been filed with the relevant authorities for their consideration.

- **National Energy Conservation Strategy**

The project complies with the three explicit objectives of the NECS: conservation of natural resources, promotion of sustainable development, and improvement of efficiency in the use and management of resources; and would also abide by policies outlined for pollution control as in s.no 4, 8, 10, 12 and 13 of the 14 core programme areas.

- **National Environment Policy**

The project is in unison and support of the NEP, particularly contents of 3.4, 3.4(h), 3.6, 3.7, 3.9, 4.1, 4.3, 4.4, 5.4, 5.5 and 5.6.

- **National Forestry Policy**

The project is in harmony with the National Forestry Policy and although being situated in a desert namely Cholistan it will contribute to the national grid and hence meet the objectives of Para 1.2 by generating power from solar energy which will indirectly hinder cutting of mountain trees for firewood. It also supports Para 7, 10.2, and 10.3.

- **National Renewable Energy Policy**

The project complies with NREP, articles 4 (4.4), 8.1, and 8.3 (8.3.3)

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- **Medium-term Development Framework**

The project supports Medium term Development Framework objectives such as poverty reduction, upgrading of physical infrastructure, energy security, accelerated development of lesser developed areas, and environment.

- **Pakistan Environmental Protection Agency Regulations 2000**

Environmental impact assessment or Initial Environment Examination is not required for solar power projects in Pakistan as per section 3 and 4 of the Pakistan Environmental Protection Agency's Regulations 2000. However a complete IEE Document has been prepared for the project.

- **Other Relevant Policies and Plans of the Government**

The project complies and is in harmony with all relevant concerned policies of the government of Pakistan. Not result in any obligation towards the investor country other than Certified Emission Reduction (CER) authorization. The project will not result in any obligation towards the investor country other than CER authorization.

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### III. Description of the Project

#### Project Location

Comprehensive due diligence was carried out by experts and representatives from all stakeholders of the project, which was followed by a review and selection procedure. The site selected encompasses an area of 500 Acres (Chuk. No: 314 A Block No: 3, 4, 23, 24) which is approximately 3 to 4 Km away from the Marot Grid Station and about 50 km from Bahawalpur (the nearest urban city). **Extract 1** shows the Coordinates of the project, while **Extract 2** shows the geographical location of the project.

#### Extract 1: Coordinates of the project

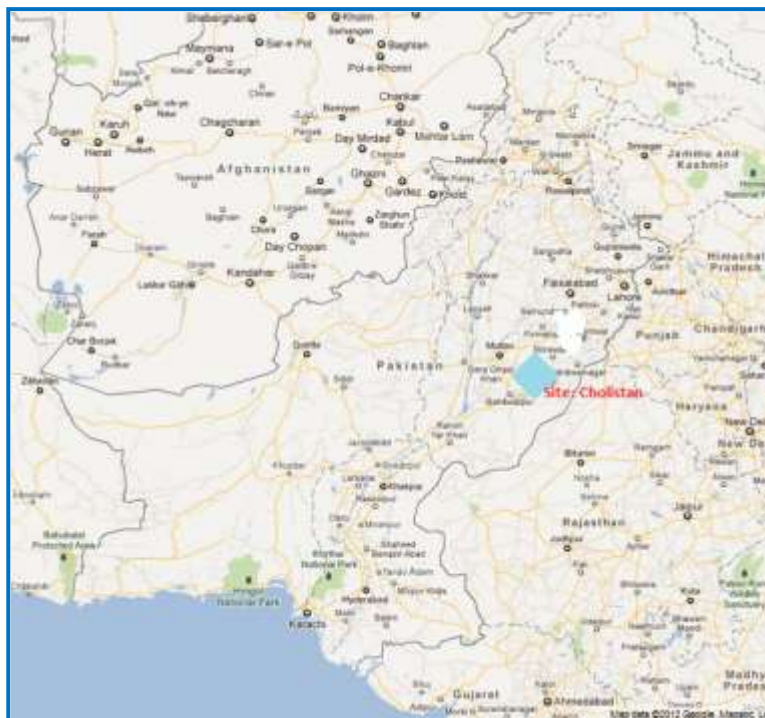
#### WK 50 MW Project Coordinates

Node	Longitude (East)	Latitude (North)
1	72 26.242	29 11.715
2	72 25.824	29 11.715
3	72 25.824	29 11.552
4	72 25.206	29 11.552
5	72 25.206	29 10.900
6	72 25.412	29 10.900
7	72 25.412	29 10.737
8	72 25.618	29 10.737
9	72 25.618	29 10.574
10	72 26.03	29 10.574
11	72 26.03	29 11.552
12	72 26.242	29 11.552

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## Extract 2: Geographical location of the project



## Scope and Layout

After review of the equipment which would need to be utilized to ensure optimized performance and maximum yield generation, the Project Layout has been designed to utilize 28 of “1.6 MW Inverter” combined units of SMA 800 CP Series Inverters (Actual power output at test conditions is 1.76 MW for each unit) which are further connected to 28 SMA Low to Medium range voltage transformers at approximately 360V AC, one for each 1.6 MW unit respectively, leading finally to the switch gear or transformer from medium to high voltage range for connection to the Grid Station at 132KV . Each unit of 1.6 MW will consist of 7480 panels, 2 inverters and 1 transformer.

A string concept is being used with 22 modules connected to a string, and 17 strings connected on a Bus leading to the SMA Inverters connection in parallel with a total of 10 such connections. The total number of PV modules used in this arrangement would be 3356 units per 1.6 MW with a total of approximately 28 such units for the complete 50 MW setup.

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## Extract 3 Technical specifications of the modules

Module Technology	Crystalline	Thin-Film
Generation	1 <sup>st</sup>	2 <sup>nd</sup>
Market Shares (2008)	84 %	16 %
Data Availability	Old Technology; Data is available for analysis	Relatively Newer Technology; Data is scant for reliability analysis
Efficiency	Mono crystalline: 17 % Poly crystalline: 13.5 %	9 %
Lowest Retail Price (\$/watt)	High Mono Crystalline: 1.20 Poly Crystalline: 1.08	Low 0.81
Weight to Power Ratio	Small	Large
Module Size	Large range 65 – 240 W	Small Range 65 – 130 W

The modules to be selected for the project should have in built features for extreme weather conditions to be suitable for the project site. The modules would be subject to conditions such as temperatures exceeding 50 oC, wind speeds exceeding 5 m/s, and precipitation on panels in case of rare occasional occurrence of a sand-storm. Therefore, modules should consist of materials that have high tolerance to these conditions and more, meaning a high factor of safety and resilience. Additionally, the modules should allow for easy and fast maintenance along with cleaning operations.

## Construction

The land acquired by Welt Konnect consists primarily of flat ground and sand dunes. Construction of the solar farm will be focused on the flat areas. Scant vegetation (shrubs and bushes) is found in these areas causing no troubles regarding shading. The panels would be mounted on racks, facing due south, at an angle of 30 degrees above horizontal to maximize the system for annual energy production. The mounting racks would be aligned in rows along an east-west axis across the entire area defined for the project. Depending on the height of the panels off the ground, it is estimated that approximately five to six feet of spacing between rows would be required to prevent shading from one row of modules onto the other.

A single string of 224 PV modules require approximately 16 meters x 42 meters where as a single inverter (3740 units of PV modules) requires 100 meters x 120 meters. The total requirement for construction of 209,440 units of PV modules is

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approximately 1,500,000 m<sup>2</sup> (375 acres) which is clearly within the value of the acquired land. There are three options that can be utilized when setting the tracking system of a photo-voltaic powered power plant namely single axis, dual axis or no tracking system.

Design optimization shows that for such a large number of panels, a tracking system would require a large initial investment as well as yearly maintenance for a relatively lower amount of increase in yield. Therefore the company has opted to utilize no tracking system

The modules would be clamped to a long term resistant mounting structure (details of which are provided in subsequent sections). The mountings will be made with considerations of stress analysis in weight and wind conditions.

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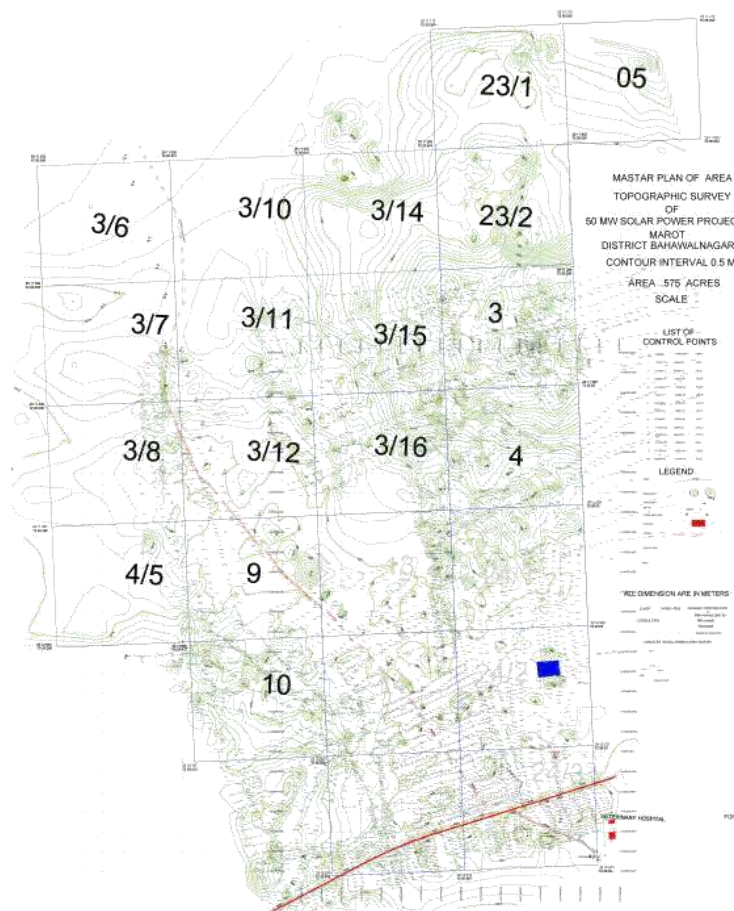
## IV. Description of Environment

### Site Condition

The land acquired by the Joint Venture consists primarily of flat ground and scarce sand dunes at the peripheral of the site. Construction of the solar farm will be focused on the flat areas.

Cholistan has very low propensity towards natural disasters or similar risks. Till date the nearest area to Cholistan which has faced the effects of a flood is Bahawalpur and that too only once in history. Cholistan and nearby areas for a significant radius are not prone to earth quakes (as per past records). The Project is strategically positioned between the Farm Lands being irrigated by man made canals taken out from the Indus River passing through Punjab on its way to Sindh which cover it on 3 sides and on the other hand the Marot Fort with its high elevation. **Extract 4** represents the topographic survey of the project site.

**Extract 4: Topographic Survey of the Site**



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### Micro Climate Effects

The Pakistan Meteorological Department is both a scientific and a service department, and functions under the Ministry of Defense. It is responsible for providing meteorological service throughout Pakistan to wide variety of interest and for numerous public activities and projects which require weather information.

In its services to aviation the department's responsibility goes to some extent beyond national boundaries in fulfillment of accepted international agreements and obligations which include, among other things, the collection and rebroadcast of meteorological data.

Apart from meteorology, the department is also concerned with Agro meteorology, Hydrology, Astronomy and Astrophysics (including solar physics), Seismology, Geomagnetism, Atmospheric Electricity and studies of the Ionosphere and Cosmic Rays. Pakistan Meteorological Department shoulders the responsibility to investigate the factors responsible for global warming, climate change its impact assessment and adaptation strategies in various sectors of human activities.

Microclimate effects of Cholistan and nearby area are characterized by low and rare sporadic rain. The mean annual rainfall varies from less than 100 mm in the west to 200 mm in the east and as per collected Synthetic Data, installed SRA equipment on site and information gathered from Locals, it rains only 1 to 3 times a years.

Rain usually falls during monsoon (July through September), winter and spring (January through March). Aridity is the most striking feature of the Cholistan desert with wet and dry years occurring in clusters. Cholistan is one of the hottest regions of Pakistan. Temperatures are high in summer and mild in winter. The mean summer temperature (May, June) is 34 °C with the highest reaching above 51 °C. **Extract 5** gives us the meteorological details of the site.

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## Extract 5 The meteorological details of the site

	Average Temperature °C		Average Humidity %	Precipitation (mm/day)
Months	Min	Max		Mean
Jan	6.95	19.9	45.3	0.30
Feb	9.19	22.9	38.2	0.61
Mar	15.1	29.3	29.3	0.66
Apr	20.8	34.2	27.4	0.52
May	25.3	37.9	30.3	0.54
Jun	28.2	38.2	43.4	1.22
Jul	28.0	35.1	61.8	3.63
Aug	26.9	33.4	67.7	2.95
Sep	24.8	33.8	55.4	1.22
Oct	19.3	32.6	33.5	0.40
Nov	13.8	27.8	31.6	0.09
Dec	8.99	22.2	39.1	0.23

## Soil, Water and Vegetation Condition

The investigated site is located at Marot, Tehsil Fort Abbas, District Bhawalnagar. The area is mainly underlain by Sandy Silty Clay up to the maximum explored depth.

### Soil

The onsite material is generally classified as SANDY SILTY CLAY (CL-ML) group of Unified Soil Classification System. Prior to any construction activity, the site must be cleared of all debris and surface vegetation. The leveling and grading can be carried out by normal earth moving machine. It is recommended that immediately after excavation for construction of foundation or other substructures, the excavation bottoms and slopes are cleared of all debris, proof rolled and covered by a 5 cm thick blinding concrete layer.

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### Water

The site is facilitated with a very favorable level of water table, less than 20m below ground level. The project team would drill bores to gain access to this water table and its supply. Simultaneously for initial work scope, there are existing wells within approachable distance which are being used by local habitants for their live stock.

### Vegetation

Scant vegetation (shrubs and bushes) is found in these areas causing no troubles regarding shading. The panels would be mounted on racks, facing due south, at an angle of 30 degrees above horizontal to maximize the system for annual energy production.

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## V. Anticipated Impacts and Mitigation Measures

### Impacts during Construction

The civil, mechanical and electrical works will be minor and will spread over the large project site. Considering the nature and magnitude of construction works and the ecological insensitivity of the project site, it is certain that the construction would create only minor and manageable environmental disturbances such as noise from trucks and excavation equipment, which are insignificant impacts due to the absence of communities in the area. No toxic and hazardous materials will be used in the construction apart from diesel oils for vehicles, which will be properly stored. The construction contracts will require the EPC contractors to be responsible for undertaking effective measures for environmental impact mitigation. Environmental performance of the EPC contractors will be monitored by the joint on site project management team, specifically the personnel of HSE Department.

### Impacts during Operation

The solar power plant does not create noise and gaseous emissions during operation. A small volume of wastewater would be daily generated from washing dust from surface of the solar panels. This wastewater contains only suspended solids and will be drained into the storm drainage basin. Not more than 10 staff for operation and for maintenance such as PV surface cleaning; Domestic wastes generated by this small number of people could be readily handled by a septic tank system.

The potential impacts could be visual and reflection. However, as the project site and the surrounding areas provide no significant aesthetic value, the sights of a large area covered with solar PV panels will have no visual impact. With the old design of solar PV arrays, reflected sunlight may cause problems if the system is close to a road and is facing in a direction which the reflected sunlight may cause problems. This problem will not occur in this Project as its surface of solar PV panels is designed to absorb sunlight and minimize sunlight reflections. Though the reflection problem will not occur because the panels are designed to absorb sunlight, the project team will plant trees along the road as green belt.

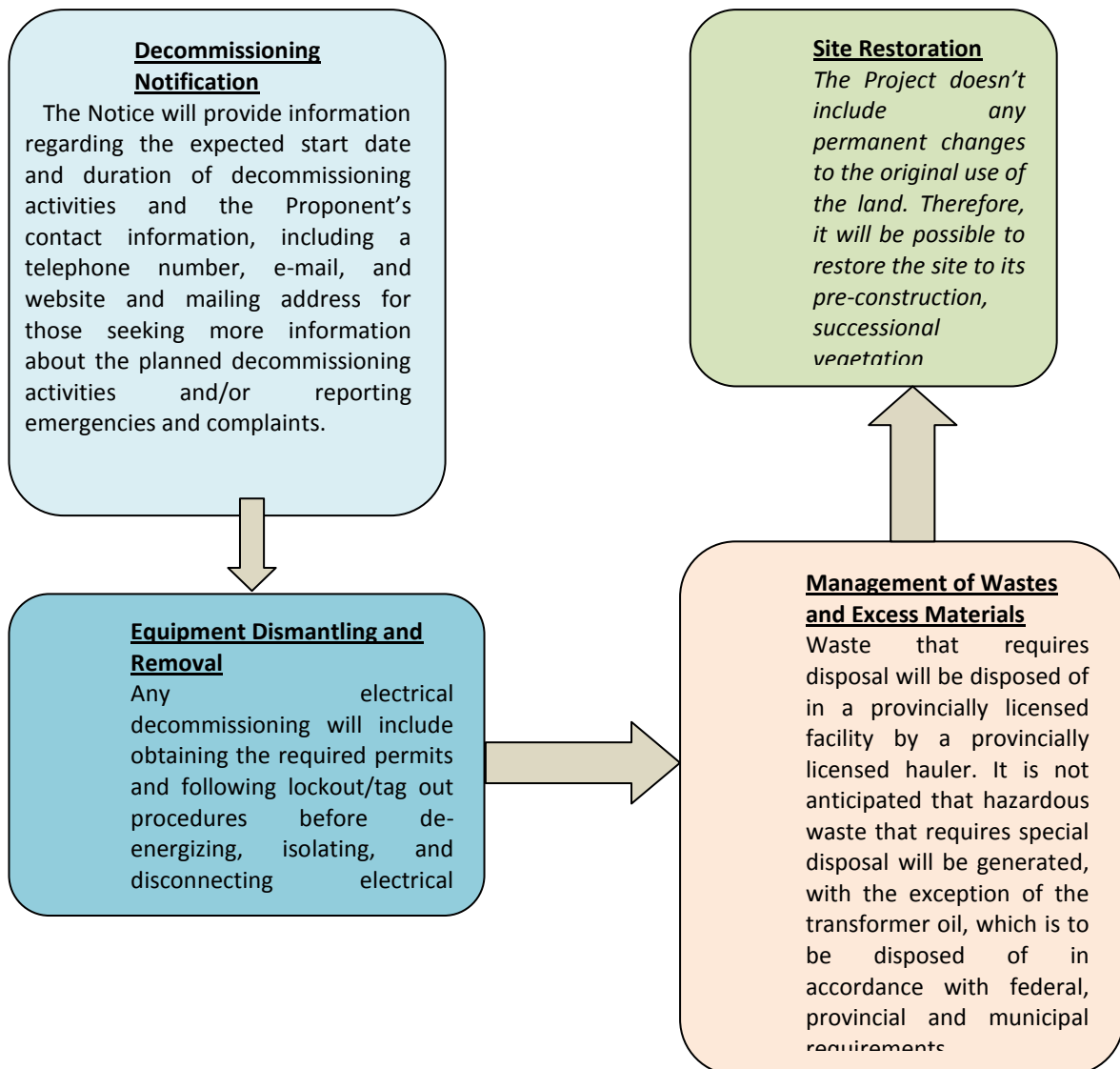
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### Decommissioning

**Welt Konnect & CTGI** will ensure that the entire Project Location is restored back to its pre-construction condition (successional vegetation land use or as may be appropriate at that time) and that the decommissioning is conducted in accordance with the applicable local (Bahawalpur and Cholistan bodies), provincial (Punjab Government) and federal requirements. In addition, potential effects and mitigation pertaining to significant natural features on and/or in proximity to the Project Location will be documented. Overall, no significant adverse impacts to the environment are expected as a result of decommissioning the Project. **The Flow Chart below (Extract 6: From Feasibility Report)** shows the flow chart of the decommissioning procedure.

Extract 6: Decommissioning Plan



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### Social Impacts

There will be reduction of poverty in an economically depressed region with very little industry and high unemployment as jobs are created during installation as well as operation for both unskilled and skilled workers. The skill sets of locals will be improved through training and capacity building for employment in the project contributing to technical advancement.

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## VI. Analysis of Alternatives

### Alternative Sites

With the help of the Punjab Government, 4 sites were short listed and identified in Cholistan, towards Southern Punjab with presence of the required minimum infrastructure, high irradiation levels and solar potential. After due scrutiny and deliberation by Experts over the sites; the 500 Acres strip of land located in (Chuk. No: 314 A Block No: 3, 4, 23, 24) approximately 3 to 4 Km away from the Marot Grid Station and about 50 km from Bahawalpur, the nearest urban city, was selected and finalized. The location enjoys a flat terrain with innocuous sand dunes in the peripheral, scarce plant cover, rich solar irradiation, availability of water, nearby Government Guest houses and immediate access to the power grid at about 4km, thus rendering itself a technically and logistically feasible location for the setup of a large solar power station.

### Alternative Measures

The Project's feasibility study reviewed the technical aspects and conceptual designs of multiple potential PV suppliers that would meet the requirements as set by the CTGI and Welt Konnect (Pvt.) Ltd. The winning EPC contractor will be chosen based on the following general criteria, apart from the selection criteria as will be mentioned in the pre-qualification documents:

- Displays understanding and skills to develop optimum design for the PV system for the selected site
- Has used best engineering principles in the conceptual design
- Demonstrates engineering ingenuity that will help reduce the projects capital and operation and maintenance costs
- Has over two years of experience in project management with a well developed and trained department for
  - Health
  - Safety and
  - Environment

The EPC contractors selected during the pre-qualification phase will be required to develop a complete environment management plan as part of their bidding documents.

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## VII. Grievance Redress Mechanism

At least 2 channels for environmental complaints will be created. These would comprise of complaints using emails, and telephone. The details of both these channels would be mentioned on all direction and site boards for the project. The most effective channel for response is by telephone because the contact can be made anytime and is two-way communication. No matter which channel is used, the responders from the HSE (Health, Safety and Environment) team will firstly obtain the information from the complainer as much as possible to identify source of the problem and inform the operations or maintenance departments. When the operations or maintenance department receives the information from HSE, they will find out if the complaint is caused from their operation. In case “yes”, they will fix the problem or stop their operation.

A follow up will be carried out when the operation will call back HSE staff for the situation so that HSE staff can communicate to the complainer as soon as possible. Moreover, HSE staff will also meet the complainer, if required and possible, at site for better understanding and curing his/their feelings and inform them the progress of mitigation measures from time to time until the problem has been solved.

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## VIII. Environmental Management Plan

### Management System

After the completion of this 50MW Solar PV Project, a joint management organization will be established with the principle of requiring “few on-duty staff”. After the electrical equipment and machinery have entered their stable operation mode, the PV plant shall be managed with “no on-call staff and few on-guard staff”.

The WK & CTGI 50 MW PV Plant is divided into the production area and the utility area. The production area includes facilities such as Solar PV panels, etc. The complex will have multiple functions of administration, living, and production. The offices of the building will consist of relay protection room (including the DC panel room), central control room, communication room, and general purpose offices. The control room, the room for distributing high and low voltage electricity, and power distribution will be arranged conveniently so as to reduce the total length of cable laying and save construction cost. The other section is for daily lives including dormitories, dining room, and kitchen.

### Housekeeping of Facility

OEMs for Solar panels are responsible for providing the generic maintenance plans for solar panels which include cleaning. The joint management between Welt Konnect, CTGI and EPC Contractor will be required to further determine the suitable cleaning requirements for the panel. This would be done by sharing complete site information (dust, dirt, pollen and/or pollution in the site environment; the frequency of rain or snow) with the OEMs for Solar panel, and ask them for site specific cleaning plans and details for the solar panels. Innovative methods for different maintenance and operation aspects are being employed all over the globe.

### Safety and Security Concerns

Responsibility for security concerns before the construction of the project will lie with the EPC Contractor with monitoring authority of Welt Konnect and CTGI. Post-construction the responsibility will lie with the joint management to develop a team and an SOP mentioning the number of personnel required for the security purpose of the facility.

Responsibility for security concerns before the construction of the project will lie with the EPC Contractor with monitoring authority of Welt Konnect and CTGI. Post-construction the responsibility will lie with the joint management to develop a team

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and an SOP mentioning the number of personnel required for the security purpose of the facility.

### **Risk Management**

The risk management plan, documents the procedures that will be used to manage risk throughout the project. In addition to documenting the results of the risk identification, it also covers who will be responsible for managing various areas of risk, how risks will be tracked throughout the project, and how plans of action will be implemented.

Risk management plan is an assessment tool that may be used in the project oversight process. For the 50 MW Solar PV Power Project in Cholistan, the RMP includes at least the following information:

- Purpose and scope
- Risk management methodology
- Overview or summary of risk
- Risk identification
- Risk analysis
- Risk response planning
- Risk monitoring and controls

### **Emergency Response Processes**

During the construction and operation of the project, the guideline of “safety first, (accident) prevention foremost” will be practiced. Comprehensive management and supervision will be applied to all staff members and the whole operation process, in order to ensure safe operation of the equipment and personnel safety of the workers. The safety and health supervision department will provide appropriate inspection equipment, as well as necessary public education service for production safety.

HSE personnel will be required to draft emergency shutdown procedures for the plant in collaboration with the maintenance and project department during the detailed design phase of the Project. These would include all procedures in case of fire, lightning, flood, other natural disasters, etc. The procedures would be based on the guidelines from OSHA Standards (29 CFR 1910).

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## Social Development

For the purpose of measuring Social Development the “JEDI - Jobs and Economic Development Impact” model of evaluating socio economic factors has been employed. The (JEDI) models are user-friendly tools that estimate the economic impacts of constructing and operating power generation and biofuel plants at the local level. Based on project-specific and default inputs (derived from industry norms), JEDI estimates the number of jobs and economic impacts to a local area (usually a state) that could reasonably be supported by a power generation project.

For example, JEDI estimates the number of in-state construction jobs from a new solar project. JEDI models are input-output models designed to provide reasonable estimates, not exact numbers. JEDI also provides estimates on land lease and property tax revenues, when appropriate.

Various ownership and financing structures can be incorporated by the user as well. Results obtained for the impact of this project on the local employment can be represented by empirical changes on employer payroll. This can be seen in **Extract 7: Empirical results of Using JEDI with Cost estimates on employer payroll.**

PV System Annual Operating and Maintenance Costs			Manufactured
	Cost	Local Share	Locally (Y or N)
Labor			
Technicians	\$136,667	100%	
Subtotal	\$136,667		
Materials and Services			
Materials & Equipment	\$113,333	100%	N
Services	\$0	100%	
Subtotal	\$113,333		
Sales Tax (Materials & Equipment Purchases)	\$9,350	100%	
Average Annual Payment (Interest and Principal)	\$1,508,000	0%	
Property Taxes	\$0	100%	
Total	\$1,767,350		
<b>Other Parameters</b>			
Financial Parameters			
Debt Financing			
Percentage financed	80%	0%	
Years financed (term)	10		
Interest rate	10%		
Tax Parameters			
Local Property Tax (percent of taxable value)	0%		
Assessed Value (percent of construction cost)	0%		
Taxable Value (percent of assessed value)	0%		
Taxable Value	\$0		
Property Tax Exemption (percent of local taxes)	100%		
Local Property Taxes	\$0	100%	

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Local Sales Tax Rate	8.25%	100%
Sales Tax Exemption (percent of local taxes)	0%	
Payroll Parameters	<b>Wage per hour</b>	<b>Employer Payroll Overhead</b>
Construction and Installation Labor		
Construction Workers / Installers	\$21.39	45.6%
O&M Labor		
Technicians	\$21.39	45.6%

**Extract 7:** Empirical results of Using JEDI with Cost estimates on employer payroll

The current recession being faced by the globe has shifted the attention towards major socio-economic disasters such as inflation, industries crashing, unemployment rise, and standards of living reducing dramatically. Pakistan and the nearby region has been a victim of these conditions prior to recessions and is expected to keep facing similar situations in the aftermath of recess.

Projects like these provide us with the two major solutions to problems which form the foundation of social and economic disasters; Employment and cheap power for comfort. Through projects of this scale and nature, direct benefits to the community and economy are that of:

- Immediate employment
- Cheap energy and comfort

Some indirect and important benefits are:

- A Creation of a local market and/or of a local industry for PV products and services
- Security of energy supply
- Poverty alleviation, Creation of education facilities (need of skilled personnel)
- Recovery of vegetation due to improved irrigation / improved access to safe drinking water due to solar water purification

All methods employed during the engineering, procurement and construction phase have not only been screened to develop opportunities in Pakistan but also to cater to important requirements such as providing a healthy environment to the community. This project will also play a crucial role in improving awareness on renewable energy and in turn on the right consumption pattern of power for consumers.

The project holds complete compliance to every law and rule set down by the Government of Pakistan, Provincial government of Punjab, regulatory bodies for

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power, and regulatory bodies for Economics such as SECP and regulatory requirements of Environment.

At an early stage of PV power development it is not likely that PV modules or cells for large power plants will be produced in Pakistan, so the creation of local industry should not be overestimated in beginning of the development of a the national PV market.

### Environmental Impacts Mitigation

The requirements set by the Government of Pakistan and the Provincial Government of Punjab on different aspects of environment have been reviewed in detail. Apart from the primary requirements of IEE, EIA and NEQS there are multiple legislations and laws that need to be considered for any power generation projects in Pakistan. For renewable energy projects, these laws and legislations belong to 14 various sectors.

Solar projects are out of the scope of noise sector, as opposed to those of wind power projects.

Renewable Energy Projects do not have relevance to the sectors or concerns of Toxic or hazardous substances, Air Quality, Marine and Fisheries (except for any wind power projects undertaken which is off-shore), mineral Development and Public health and safety.

PV Power and Biogas projects do need to consider all laws set by sectors of livestock and solid wastes.

Important issues with the Solar PV Project and other similar projects in the region have to pay serious attention to the selection site for power generation to cater to the environmental standards as set by sectors like forest conservation, Parks and Wildlife conservation, cultural environment, Environmental protection, Land use and water quality and resources.

Considering the size of this project, primary focus was kept on the laws and legislations of land use set by the Provincial Government of Punjab, meaning the Land acquisition Act 1984, Soil Reclamation Act 1964 and The Punjab Development of Damaged Areas Act 1952. Damaged areas have been defined as any area that is declared damaged by the government through notification.

The Project Site is not used for agriculture farming due to very arid climate and undulating topography. Neither is livestock grazing an option due to the limiting weather conditions of the Land There is scarcity of drinking water both for humans and scarce livestock. As a result livestock production is less than its potential.

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Groundwater is never the less available less than 20 meters below the surface however in some locations it is too saline to drink. The main method of keeping animals in areas further away from this hyper-arid region is a free availability of forage and monsoon rains which leave water stored in the pools dug in past by their owners.

Main soil types of Cholistan desert are sand dunes (44%), sandy soils (37%), loamy soils (2%) and saline-sodic clayey soils (17%).

The 50 MW Cholistan Solar PV Power project is exempted from all requirements of IEE and EIA as it falls under the schedule II classified by Pakistan Environmental Protection Agency regulations 2000, S.R.O 339(1)/2001. The project has also been planned to fulfill all requirements of Clean Development.

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## IX. Conclusions And Recommendations

Environmental impact assessment or Initial Environment Examination is not required for solar power projects in Pakistan as per section 3 and 4 of the Pakistan Environmental Protection Agency's Regulations 2000. However a complete IEE Document has been prepared for the project. This step has been taken to document all the reasons that are in line with all policies and regulations mentioned in this report; based on which the project has already obtained a No Objection Certificate.

The project site is not used for agriculture, is not located in a sensitive ecosystem, and has no historical and cultural value. This nature of the project site coupled with the clean nature of solar power generation ensures that the Project will not cause any significant, lasting environmental and social impacts during construction, operation and decommissioning. Only minor and transient environmental disturbances would be experienced at the project site during construction and operation, and they will be minimized through implementation of the Environment Management Procedures. It is then recommended that the Project be considered environmentally and socially feasible, and that this IEE is adequate to justify environmental and social feasibility of the Project. There is no need for further analysis and the environmental and social assessment of the Project is considered complete.

Project owners are fully committed to their environmental and social responsibility and discharge this responsibility in adherence to principles of good corporate governance. In their daily business operations, CTGI and WK fully meet the environmental, occupational health, and safety requirements and risk management within the basic framework of globally recognized environmental management system standard. Its staff and contractors are fully committed to their environmental responsibility and discharge their responsibility within the HSE policy and operational framework.

WK and CTGI discharge their social responsibility through: (i) fair treatment of its employees in full compliance with all applicable laws and regulations; and (ii) supporting community participation and development activities through its CSR program. Involuntary resettlement and indigenous peoples are not relevant issues in the operations of the project owners and are unlikely to become relevant issues in its future operations.

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### 3 ENVIRONMENT IMPACT ANALYSIS (EIA)

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### I. Application Form (As per Schedule IV in PEPPA 2000)

1	Name and Address of Proponent		Phones: Fax: Telex:	
2	Description of Project			
3	Location of Project			
4	Objectives of Project			
5	IEE/EIA attached?	IEE / EIA: <u>Yes</u> /No:		
6	Have alternatives been considered and reported in IEE or EIA	<u>Yes</u> / No		
7	Existing Land Use		Land Requirement	
8	Is the basic Site data available or has it been measured?	(only tick yes if the data is reported in the IEE/EIA)  Meteorology (including rainfall) <u>Yes</u> /No Ambient Air Quality <u>Yes</u> /No Ambient Water Quality <u>Yes</u> /No Ground Water Quality <u>Yes</u> /No	<u>Available</u>  <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No	<u>Measured</u>  <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No
9	Have estimates of the following been reported?	Water Balance Solid Waste Liquid Waste treatment	<u>Estimated</u> <u>Yes</u> /No <u>Yes</u> /No <u>Yes</u> /No	<u>Reported</u> Yes/ <u>Not Applicable</u> Yes/ <u>Not Applicable</u> Yes/ <u>Not Applicable</u>
10	Source of Power		Power Requirement	
11	Labor Force (number)	Construction: Operation:		

#### Verification

I do solemnly affirm and declare that the information given above and contained in the attached IEE/EIA is true and correct to the best of my knowledge and belief.

Date \_\_\_\_\_

\_\_\_\_\_  
 Signature, name and designation of  
 Proponent (with official stamp/seal)

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## II. Policy Legal and Administrative Framework

As per the general criteria the project should be consistent with the national laws and sustainable development policies, strategies and plans including:

- **Pakistan Environmental Protection Act- 1997**

The project is in compliance with the PEPA 1997, and as mentioned in Para 12 of the said act, this project being a solar PV project in a desert with almost no population or wildlife or plantation, does not have any adverse effect on the environment whatsoever. However an Environment studies have been filed with the relevant authorities for their consideration.

- **National Energy Conservation Strategy**

The project complies with the three explicit objectives of the NECS: conservation of natural resources, promotion of sustainable development, and improvement of efficiency in the use and management of resources; and would also abide by policies outlined for pollution control as in s.no 4, 8, 10, 12 and 13 of the 14 core programme areas.

- **National Environment Policy**

The project is in unison and support of the NEP, particularly contents of 3.4, 3.4(h), 3.6, 3.7, 3.9, 4.1, 4.3, 4.4, 5.4, 5.5 and 5.6.

- **National Forestry Policy**

The project is in harmony with the National Forestry Policy and although being situated in a desert namely Cholistan it will contribute to the national grid and hence meet the objectives of Para 1.2 by generating power from solar energy which will indirectly hinder cutting of mountain trees for firewood. It also supports Para 7, 10.2, and 10.3.

- **National Renewable Energy Policy**

The project complies with NREP, articles 4 (4.4), 8.1, and 8.3 (8.3.3)

- **Medium-term Development Framework**

The project supports Medium term Development Framework objectives such as poverty reduction, upgrading of physical infrastructure, energy security, accelerated development of lesser developed areas, and environment.

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- **Pakistan Environmental Protection Agency Regulations 2000**

Environmental impact assessment or Initial Environment Examination is not required for solar power projects in Pakistan as per section 3 and 4 of the Pakistan Environmental Protection Agency's Regulations 2000. However a complete IEE Document has been prepared for the project.

- **Other Relevant Policies and Plans of the Government**

The project complies and is in harmony with all relevant concerned policies of the government of Pakistan. Not result in any obligation towards the investor country other than Certified Emission Reduction (CER) authorization. The project will not result in any obligation towards the investor country other than CER authorization.

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### III. Description of the Project

#### Project Location

Comprehensive due diligence was carried out by experts and representatives from all stakeholders of the project, which was followed by a review and selection procedure. The site selected encompasses an area of 500 Acres (Chuk. No: 314 A Block No: 3, 4, 23, 24) which is approximately 3 to 4 Km away from the Marot Grid Station and about 50 km from Bahawalpur (the nearest urban city). **Extract 1** shows the Coordinates of the project, while **Extract 2** shows the geographical location of the project.

#### Extract 1: Coordinates of the project

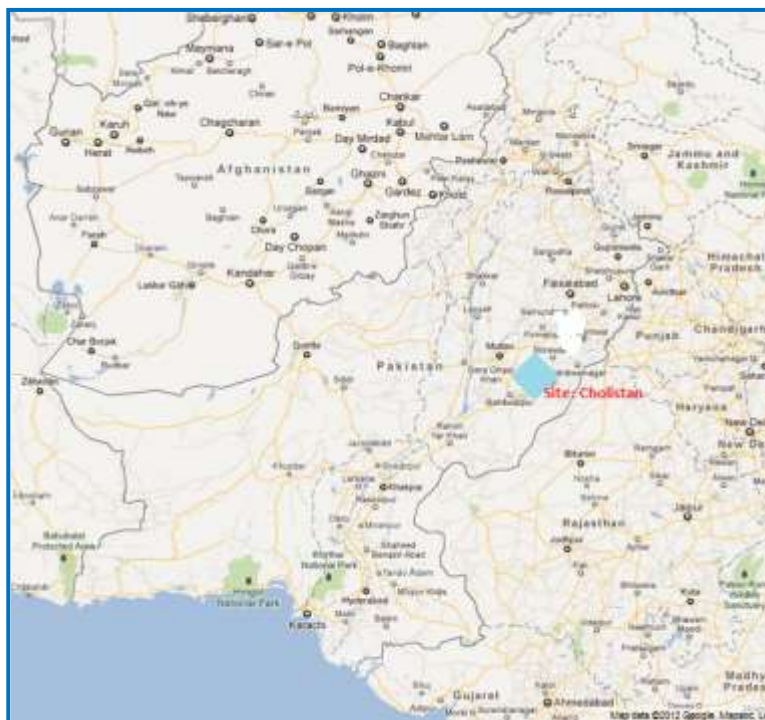
##### WK 50 MW Project Coordinates

Node	Longitude (East)	Latitude (North)
1	72 26.242	29 11.715
2	72 25.824	29 11.715
3	72 25.824	29 11.552
4	72 25.206	29 11.552
5	72 25.206	29 10.900
6	72 25.412	29 10.900
7	72 25.412	29 10.737
8	72 25.618	29 10.737
9	72 25.618	29 10.574
10	72 26.03	29 10.574
11	72 26.03	29 11.552
12	72 26.242	29 11.552

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## Extract 2: Geographical location of the project



## Scope and Layout

After review of the equipment which would need to be utilized to ensure optimized performance and maximum yield generation, the Project Layout has been designed to utilize 28 of “1.6 MW Inverter” combined units of SMA 800 CP Series Inverters (Actual power output at test conditions is 1.76 MW for each unit) which are further connected to 28 SMA Low to Medium range voltage transformers at approximately 360V AC, one for each 1.6 MW unit respectively, leading finally to the switch gear or transformer from medium to high voltage range for connection to the Grid Station at 132KV . Each unit of 1.6 MW will consist of 7480 panels, 2 inverters and 1 transformer.

A string concept is being used with 22 modules connected to a string, and 17 strings connected on a Bus leading to the SMA Inverters connection in parallel with a total of 10 such connections. The total number of PV modules used in this arrangement would be 3356 units per 1.6 MW with a total of approximately 28 such units for the complete 50 MW setup.

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## Extract 3 Technical specifications of the modules

Module Technology	Crystalline	Thin-Film
Generation	1 <sup>st</sup>	2 <sup>nd</sup>
Market Shares (2008)	84 %	16 %
Data Availability	Old Technology; Data is available for analysis	Relatively Newer Technology; Data is scant for reliability analysis
Efficiency	Mono crystalline: 17 % Poly crystalline: 13.5	9 %
Lowest Retail Price (\$/watt)	High Mono Crystalline: 1.20 Poly Crystalline: 1.08	Low 0.81
Weight to Power Ratio	Small	Large
Module Size	Large range 65 – 240 W	Small Range 65 – 130 W

The modules to be selected for the project should have in built features for extreme weather conditions to be suitable for the project site. The modules would be subject to conditions such as temperatures exceeding 50 oC, wind speeds exceeding 5 m/s, and precipitation on panels in case of rare occasional occurrence of a sand-storm. Therefore, modules should consist of materials that have high tolerance to these conditions and more, meaning a high factor of safety and resilience. Additionally, the modules should allow for easy and fast maintenance along with cleaning operations.

## Construction

The land acquired by Welt Konnect consists primarily of flat ground and sand dunes. Construction of the solar farm will be focused on the flat areas. Scant vegetation (shrubs and bushes) is found in these areas causing no troubles regarding shading. The panels would be mounted on racks, facing due south, at an angle of 30 degrees above horizontal to maximize the system for annual energy production. The mounting racks would be aligned in rows along an east-west axis across the entire area defined for the project. Depending on the height of the panels off the ground, it is estimated that approximately five to six feet of spacing between rows would be required to prevent shading from one row of modules onto the other.

A single string of 224 PV modules require approximately 16 meters x 42 meters where as a single inverter (3740 units of PV modules) requires 100 meters x 120 meters. The total requirement for construction of 209,440 units of PV modules is

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approximately 600,000 m<sup>2</sup> (150 acres) which is clearly within the value of the acquired land. There are three options that can be utilized when setting the tracking system of a photo-voltaic powered power plant namely single axis, dual axis or no tracking system.

Design optimization shows that for such a large number of panels, a tracking system would require a large initial investment as well as yearly maintenance for a relatively lower amount of increase in yield. Therefore the company has opted to utilize no tracking system

The modules would be clamped to a long term resistant mounting structure (details of which are provided in subsequent sections). The mountings will be made with considerations of stress analysis in weight and wind conditions.

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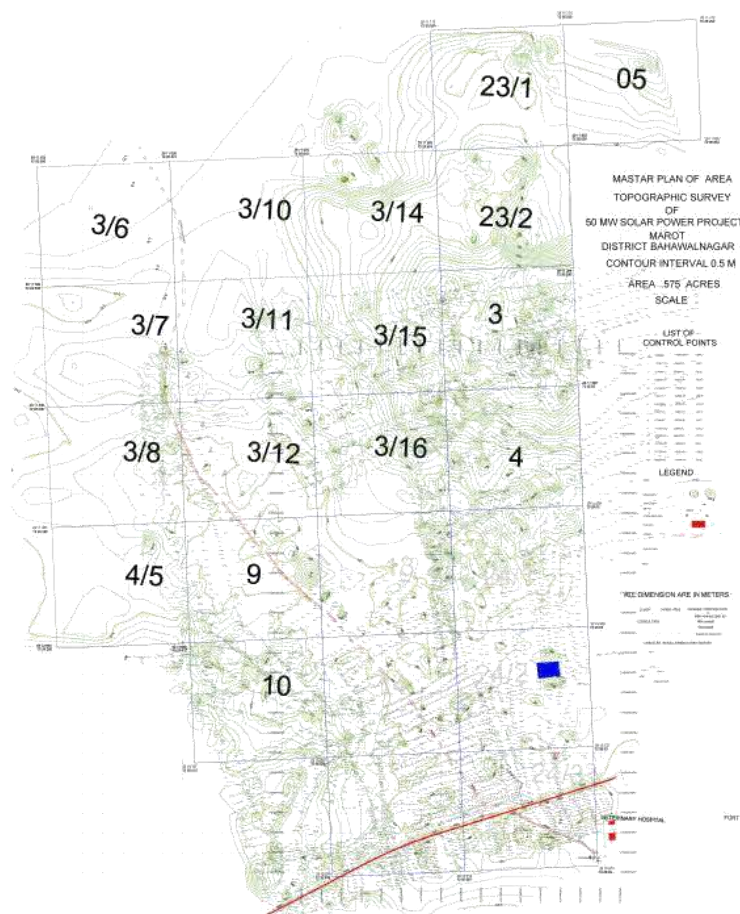
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## IV. Description of Environment

### Site Condition

The land acquired by the Joint Venture consists primarily of flat ground and scarce sand dunes at the peripheral of the site. Construction of the solar farm will be focused on the flat areas. Cholistan has very low propensity towards natural disasters or similar risks. Till date the nearest area to Cholistan which has faced the effects of a flood is Bahawalpur and that too only once in history. Cholistan and nearby areas for a significant radius are not prone to earth quakes (as per past records). The Project is strategically positioned between the Farm Lands being irrigated by man made canals taken out from the Indus River passing through Punjab on its way to Sindh which cover it on 3 sides and on the other hand the Marot Fort with its high elevation. **Extract 4** represents the topographic survey of the project site.

**Extract 4: Topographic Survey of the Site**



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### Micro Climate Effects

The Pakistan Meteorological Department is both a scientific and a service department, and functions under the Ministry of Defense. It is responsible for providing meteorological service throughout Pakistan to wide variety of interest and for numerous public activities and projects which require weather information.

In its services to aviation the department's responsibility goes to some extent beyond national boundaries in fulfillment of accepted international agreements and obligations which include, among other things, the collection and rebroadcast of meteorological data.

Apart from meteorology, the department is also concerned with Agro meteorology, Hydrology, Astronomy and Astrophysics (including solar physics), Seismology, Geomagnetism, Atmospheric Electricity and studies of the Ionosphere and Cosmic Rays. Pakistan Meteorological Department shoulders the responsibility to investigate the factors responsible for global warming, climate change its impact assessment and adaptation strategies in various sectors of human activities.

Microclimate effects of Cholistan and nearby area are characterized by low and rare sporadic rain. The mean annual rainfall varies from less than 100 mm in the west to 200 mm in the east and as per collected Synthetic Data, installed SRA equipment on site and information gathered from Locals, it rains only 1 to 3 times a years.

Rain usually falls during monsoon (July through September), winter and spring (January through March). Aridity is the most striking feature of the Cholistan desert with wet and dry years occurring in clusters. Cholistan is one of the hottest regions of Pakistan. Temperatures are high in summer and mild in winter. The mean summer temperature (May, June) is 34 °C with the highest reaching above 51 °C. **Extract 5** gives us the meteorological details of the site.

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Extract 5 gives us the meteorological details of the site

	Average Temperature °C		Average Humidity %	Precipitation (mm/day)
Months	Min	Max		Mean
Jan	6.95	19.9	45.3	0.30
Feb	9.19	22.9	38.2	0.61
Mar	15.1	29.3	29.3	0.66
Apr	20.8	34.2	27.4	0.52
May	25.3	37.9	30.3	0.54
Jun	28.2	38.2	43.4	1.22
Jul	28.0	35.1	61.8	3.63
Aug	26.9	33.4	67.7	2.95
Sep	24.8	33.8	55.4	1.22
Oct	19.3	32.6	33.5	0.40
Nov	13.8	27.8	31.6	0.09
Dec	8.99	22.2	39.1	0.23

### Soil, Water and Vegetation Condition

The investigated site is located at Marot, Tehsil Fort Abbas, District Bhawalnagar. The area is mainly underlain by Sandy Silty Clay up to the maximum explored depth.

#### Soil

The onsite material is generally classified as SANDY SILTY CLAY (CL-ML) group of Unified Soil Classification System. Prior to any construction activity, the site must be cleared of all debris and surface vegetation. The leveling and grading can be carried out by normal earth moving machine. It is recommended that immediately after excavation for construction of foundation or other substructures, the excavation bottoms and slopes are cleared of all debris, proof rolled and covered by a 5 cm thick blinding concrete layer.

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### Water

The site is facilitated with a very favorable level of water table, less than 20m below ground level. The project team would drill bores to gain access to this water table and its supply. Simultaneously for initial work scope, there are existing wells within approachable distance which are being used by local habitants for their live stock.

### Vegetation

Scant vegetation (shrubs and bushes) is found in these areas causing no troubles regarding shading. The panels would be mounted on racks, facing due south, at an angle of 30 degrees above horizontal to maximize the system for annual energy production.

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## V. Analysis of Alternatives

### Alternative Sites

With the help of the Punjab Government, 4 sites were short listed and identified in Cholistan, towards Southern Punjab with presence of the required minimum infrastructure, high irradiation levels and solar potential. After due scrutiny and deliberation by Experts over the sites; the 500 Acres strip of land located in (Chuk. No: 314 A Block No: 3, 4, 23, 24) approximately 3 to 4 Km away from the Marot Grid Station and about 50 km from Bahawalpur, the nearest urban city, was selected and finalized. The location enjoys a flat terrain with innocuous sand dunes in the peripheral, scarce plant cover, rich solar irradiation, availability of water, nearby Government Guest houses and immediate access to the power grid at about 4km, thus rendering itself a technically and logistically feasible location for the setup of a large solar power station.

### Alternative Measures

The Project's feasibility study reviewed the technical aspects and conceptual designs of multiple potential PV suppliers that would meet the requirements as set by the CTGI and Welt Konnect (Pvt.) Ltd. The winning EPC contractor will be chosen based on the following general criteria, apart from the selection criteria as will be mentioned in the pre-qualification documents:

- Displays understanding and skills to develop optimum design for the PV system for the selected site
- Has used best engineering principles in the conceptual design
- Demonstrates engineering ingenuity that will help reduce the projects capital and operation and maintenance costs
- Has over two years of experience in project management with a well-developed and trained department for
  - Health
  - Safety and
  - Environment

The EPC contractors selected during the pre-qualification phase will be required to develop a complete environment management plan as part of their bidding documents.

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## VI. Potential and Significant Environment Impacts

Photovoltaics (PV) are seen to be generally of benign environmental impact, generating no noise or chemical pollutants during use. It is one of the most viable renewable energy technologies for use in an urban environment, replacing existing building cladding materials.

It is also an attractive option for use in scenic areas and National Parks, where the avoidance of pylons and wires is a major advantage.

### Land use

The impact of land use on natural ecosystems is dependent upon specific factors such as the topography of the landscape, the area of land covered by the PV system, the type of the land, the distance from areas of natural beauty or sensitive ecosystems, and the biodiversity. The impacts and the modification on the landscape are likely to come up during construction stage by construction activities, such as earth movements and by transport movements. Furthermore, an application of a PV system in once-cultivable land is possible to damnify soil productive areas.

### Routine and accidental discharges of pollutants

During their normal operation PV systems emit no gaseous or liquid pollutants, and no radioactive substances. In the case of CIS and CdTe modules, which include small quantities of toxic substances, there is a potential slight risk that a fire in an array might cause small amounts of these chemicals to be released into the environment. In large-scale central plants a release of these hazardous materials might occur as a result of abnormal plant operations and it could pose a small risk to public and occupational health. Thus there must be emergency preparedness and response in case of an accidental fire or exposure to heat. Emissions to soil and groundwater may occur due to inadequate storage of materials.

### Visual impacts

Visual intrusion is highly dependent on the type of the scheme and the surroundings of the PV systems. It is obvious that, if we apply a PV system near an area of natural beauty (as the project site is also near tourist locations such as “Fort Abbas”); the visual impact would be significantly high. In case of modules integrated into the facade of buildings, there may be positive aesthetic impact on modern buildings in comparison to historic buildings or buildings with cultural value. Following considerations should be a part of the impact mitigation measures:

\* Optimal architectural solutions to minimize potential impact on visual amenity and building aesthetics. Advances in the development of multi-functional PV facades,

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which perform aesthetic and practical functions such as shading and heat extraction, have provided an important stimulus for architectural expression.

- \* Proper siting and design of large PV installations.
- \* Use of color to assemble the PV modules in large scale systems.

Integrated PV electrification schemes, which help to regenerate rural areas and user associations, have successfully overcome the problems of managing and maintaining remote schemes by establishing mechanisms for collecting user payments, arranging regular maintenance, obtaining finance and providing advice on energy efficient appliances.

### Depletion of natural resources

The production of current generation PV's is rather energy intensive (especially the poly crystalline and the mono-crystalline modules) and large quantities of bulk materials are needed (thin film modules have less primary energy requirement per W than the a-Si PV modules (a-Si are thin films also!) because of the difference in cell efficiency, so can be an answer to that problem). Also, small quantities of scarce materials (In/Te/Ga) are required; also limited quantities of the toxic Cd.

In general the Cd emissions attributed to CdTe production amount to 0.001% of Cd used (corresponding to 0.01 g/GWh). Furthermore Cd is produced as a byproduct of Zn production and can either be put to beneficial uses or discharged into the environment. Several aspects have to be studied to minimize environmental impacts related to the production of the PV cells:

- \* Prospects for thinner cell layers;
- \* The full potential of the concentrator PV technologies;
- \* Prospects for more efficient material utilization;
- \* Safer materials and alternatives; and
- \* Module recycling technology and its efficiency.

### Air pollution

As far as life cycle assessment is concerned, the environmental performance of the system depends heavily on the energy efficiency of the system manufacturing and especially electricity production. The emissions associated with transport of the modules are insignificant in comparison with those associated with manufacture. Transport emissions were still only 0.1–1% of manufacturing related emissions. In the case of poly- and mono-crystalline modules, the estimated emissions are 2.757–3.845 (kg CO<sub>2</sub>/kWp), 5.049–5.524 (kgSO<sub>2</sub>/kWp) and 4.507–5.273 (NO<sub>x</sub>/kWp).

### Noise intrusion

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As with all types of construction activity, there will be little noise. Also, there will be some employment benefits during the construction phase and especially for large scheme projects, such as this 50 MW Solar PV Project, during the operational phase.

### **Waste management**

A life cycle analysis of batteries for stand-alone PV systems indicates that the batteries are responsible for most of the environmental impacts, due to their relatively short life span and their heavy metal content.

### **Impacts during Construction**

The civil, mechanical and electrical works will be minor and will spread over the large project site. Considering the nature and magnitude of construction works and the ecological insensitivity of the project site, it is certain that the construction would create only minor and manageable environmental disturbances such as noise from trucks and excavation equipment, which are insignificant impacts due to the absence of communities in the area. No toxic and hazardous materials will be used in the construction apart from diesel oils for vehicles, which will be properly stored. The construction contracts will require the EPC contractors to be responsible for undertaking effective measures for environmental impact mitigation. Environmental performance of the EPC contractors will be monitored by the joint on site project management team, specifically the personnel of HSE Department.

### **Impacts during Operation**

The solar power plant does not create noise and gaseous emissions during operation. A small volume of wastewater would be daily generated from washing dust from surface of the solar panels. This wastewater contains only suspended solids and will be drained into the storm drainage basin. Not more than 10 staff for operation and for maintenance such as PV surface cleaning; Domestic wastes generated by this small number of people could be readily handled by a septic tank system.

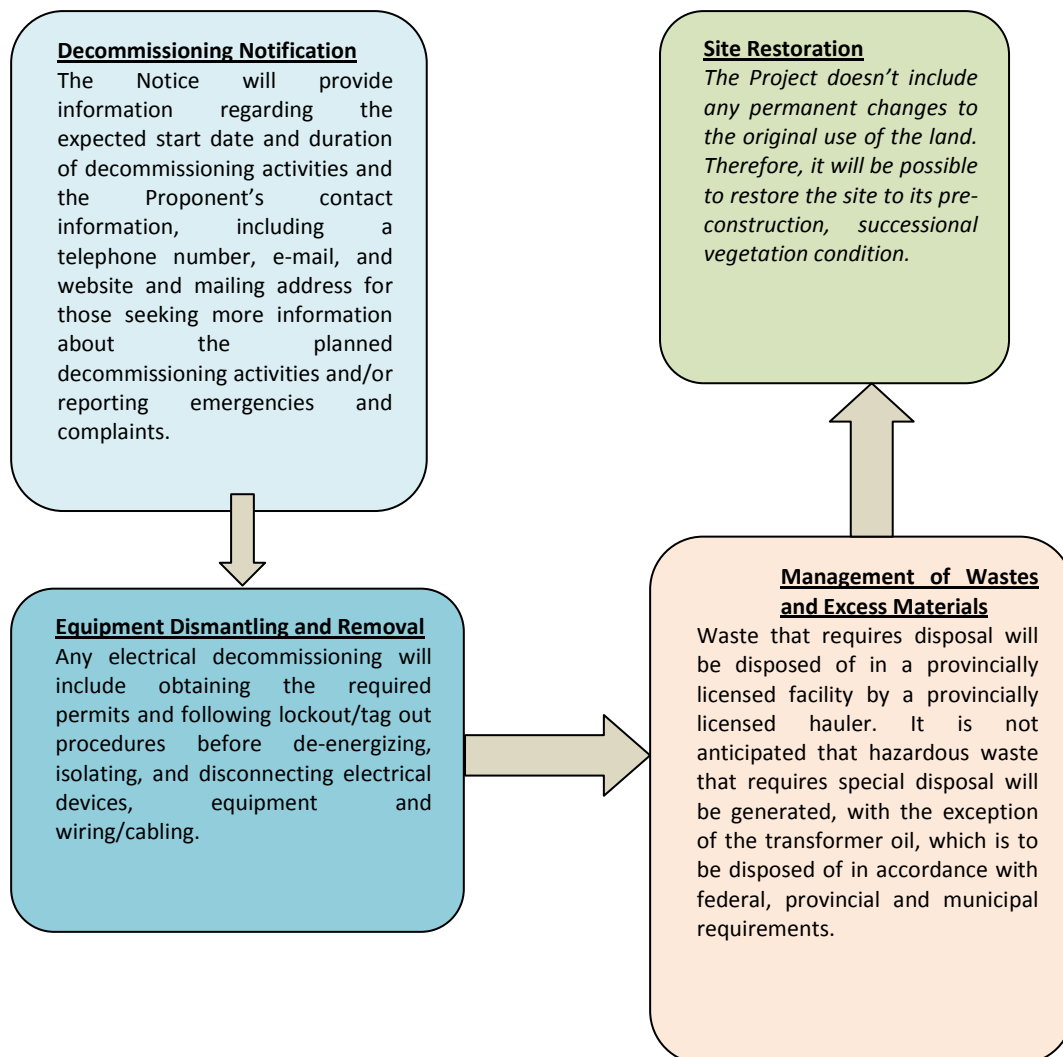
The potential impacts could be visual and reflection. However, as the project site and the surrounding areas provide no significant aesthetic value, the sights of a large area covered with solar PV panels will have no visual impact. With the old design of solar PV arrays, reflected sunlight may cause problems if the system is close to a road and is facing in a direction which the reflected sunlight may cause problems. This problem will not occur in this Project as its surface of solar PV panels is designed to absorb sunlight and minimize sunlight reflections. Though the reflection problem will not occur because the panels are designed to absorb sunlight, the project team will plant trees along the road as green belt.

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### Decommissioning

**Welt Konnect & CTGI** will ensure that the entire Project Location is restored back to its pre-construction condition (successional vegetation land use or as may be appropriate at that time) and that the decommissioning is conducted in accordance with the applicable local (Bahawalpur and Cholistan bodies), provincial (Punjab Government) and federal requirements. In addition, potential effects and mitigation pertaining to significant natural features on and/or in proximity to the Project Location will be documented. Overall, no significant adverse impacts to the environment are expected as a result of decommissioning the Project. **The Flow Chart below (Extract 6: From Feasibility Report)** shows the flow chart of the decommissioning procedure.



Extract 6: Decommissioning Plan

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### Social Impacts

There will be reduction of poverty in an economically depressed region with very little industry and high unemployment as jobs are created during installation as well as operation for both unskilled and skilled workers. The skill sets of locals will be improved through training and capacity building for employment in the project contributing to technical advancement.

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## VII. Grievance Redress Mechanism

At least 2 channels for environmental complaints will be created. These would comprise of complaints using emails, and telephone. The details of both these channels would be mentioned on all direction and site boards for the project. The most effective channel for response is by telephone because the contact can be made anytime and is two-way communication. No matter which channel is used, the responders from the HSE (Health, Safety and Environment) team will firstly obtain the information from the complainer as much as possible to identify source of the problem and inform the operations or maintenance departments. When the operations or maintenance department receives the information from HSE, they will find out if the complaint is caused from their operation. In case “yes”, they will fix the problem or stop their operation.

A follow up will be carried out when the operation will call back HSE staff for the situation so that HSE staff can communicate to the complainer as soon as possible. Moreover, HSE staff will also meet the complainer, if required and possible, at site for better understanding and curing his/their feelings and inform them the progress of mitigation measures from time to time until the problem has been solved.

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## VIII. Measures for preventing or Mitigating Environmental Impacts

The requirements set by the Government of Pakistan, and the Provincial Government of Punjab on different aspects of environment have been reviewed in detail. Apart from the primary requirements of IEE, EIA and NEQS there are multiple legislations and laws that need to be considered for any power generation projects in Pakistan. For renewable energy projects, these laws and legislations belong to 14 various sectors.

Solar projects are out of the scope of noise sector, as opposed to those of wind power projects. Renewable Energy Projects do not have relevance to the sectors or concerns of Toxic or hazardous substances, Air Quality, Marine and Fisheries (except for any wind power projects undertaken which is off-shore), mineral Development and Public health and safety.

PV Power and Biogas projects do need to consider all laws set by sectors of livestock and solid wastes.

Important issues with the Solar PV Project and other similar projects in the region have to pay serious attention to the selection site for power generation to cater to the environmental standards as set by sectors like forest conservation, Parks and Wildlife conservation, cultural environment, Environmental protection, Land use and water quality and resources.

Considering the size of this project, primary focus was kept on the laws and legislations of land use set by the Provincial Government of Punjab, meaning the Land acquisition Act 1984, Soil Reclamation Act 1964 and The Punjab Development of Damaged Areas Act 1952. Damaged areas have been defined as any area that is declared damaged by the government through notification.

The Project Site is not used for agriculture farming due to very arid climate and undulating topography. Neither is livestock grazing an option due to the limiting weather conditions of the Land There is scarcity of drinking water both for humans and scarce livestock. As a result livestock production is less than its potential. Groundwater is never the less available less than 20 meters below the surface however in some locations it is too saline to drink. The main method of keeping animals in areas further away from this hyper-arid region is a free availability of forage and monsoon rains which leave water stored in the pools dug in past by their owners.

Main soil types of Cholistan desert are sand dunes (44%), sandy soils (37%), loamy soils (2%) and saline-sodic clayey soils (17%).

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The 50 MW Cholistan Solar PV Power project is exempted from all requirements of IEE and EIA as it falls under the schedule II classified by Pakistan Environmental Protection Agency regulations 2000, S.R.O 339(1)/2001. The project has also been planned to fulfill all requirements of Clean Development.

Furthermore, unfavorable effects of Solar Energy Technologies (SETs) are usually minor and they can be minimized by appropriate mitigation measures. The potential environmental burdens of SETs are regularly site specific, depending on the size and nature of the project. These burdens are usually associated with the loss of amenity (e.g. visual impact or noise—during the installation and the demolition phases) and the impacts can be minimized by:

1. The appropriate siting of central solar systems, which involves careful evaluation of alternative locations and estimation of expected impact (away from densely populated areas and not in protected areas or areas of significant natural beauty); the residential solar systems can be installed anywhere, especially integrated in the roofs;
2. The appropriate operational practices (including rational water use, safety measures, waste disposal practices, use of biodegradable chemicals, etc.);
3. The engagement of the public and relevant organizations in the early stages of planning, in order to ensure public acceptance;
4. The use of the best available technologies/techniques and the improvement of technology (e.g. use of air as the heat-transfer medium in central tower systems, “advanced” Sterling engines);
5. The integration in the building’s shell;
6. The sensible planning constraints and pre-development assessments (e.g. on water use, habitat loss, estimation of expected CO2 savings, etc.);
7. The training of workers, use of special sunglasses during operation and construction, use of heat insulating uniforms, familiarization with the system;
8. The re-establishment of local flora and fauna, giving the environment enough time to come up to its previously state again; and
9. Thorough Environmental Impact Assessment Studies for central solar systems.

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## IX. Environmental Impact Monitoring Program

Environmental Component	Project Stage	Parameters	Standard	Location	Frequency	Institutional Responsibility	
						Implementation	Supervision
Noise	Construction	Noise level in dB(A)	Standards as per Industrial practices	Project Site	At the start of concerned activities (Such as equipment installation or startups)	EPC Contractor and WK	Welt Konnect (Pvt) Ltd.
Physical Works	Construction	As will be specified in Contractor's plan	As will be specified in Contractor's plan	Project Site	Monthly	EPC Contractor	Welt Konnect (Pvt) Ltd.
Occupational, Healthy and Safety	Construction	As specified in HSE Plan	HSE, OSHA and other applicable standards	Project Site	Weekly	EPC Contractor	Welt Konnect (Pvt) Ltd.
	Operation	As specified in OHS Plan	Applicable standards of OSHA	Project Site	Weekly	EPC Contractor	Welt Konnect (Pvt) Ltd.

**Figure IX.1: Environmental Monitoring Program**

Significant changes in the project (e.g. projected expansions, changes in technology), changes in the type of finance (e.g. from loan to equity), and/or foreclosures will be preceded by a re-assessment of environmental risk. This is in order to determine whether the changed project carries environmental and social risks and opportunities that were not considered in the initial review. The environmental monitoring of the project should continue until the loan has been repaid, the financial institution or investor has divested its equity share in a company, or the operation has been cancelled.

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## X. Conclusions and Recommendations

Environmental impact assessment or Initial Environment Examination is not required for solar power projects in Pakistan as per section 3 and 4 of the Pakistan Environmental Protection Agency's Regulations 2000. However a complete IEE Document has been prepared for the project. This step has been taken to document all the reasons that are in line with all policies and regulations mentioned in this report; based on which the project has already obtained a No Objection Certificate.

The project site is not used for agriculture, is not located in a sensitive ecosystem, and has no historical and cultural value. This nature of the project site coupled with the clean nature of solar power generation ensures that the Project will not cause any significant, lasting environmental and social impacts during construction, operation and decommissioning. Only minor and transient environmental disturbances would be experienced at the project site during construction and operation, and they will be minimized through implementation of the Environment Management Procedures. It is then recommended that the Project be considered environmentally and socially feasible, and that this IEE is adequate to justify environmental and social feasibility of the Project. There is no need for further analysis and the environmental and social assessment of the Project is considered complete.

Project owners are fully committed to their environmental and social responsibility and discharge this responsibility in adherence to principles of good corporate governance. In their daily business operations, CTGI and WK fully meet the environmental, occupational health, and safety requirements and risk management within the basic framework of globally recognized environmental management system standard. Its staff and contractors are fully committed to their environmental responsibility and discharge their responsibility within the HSE policy and operational framework.

WK and CTGI discharge their social responsibility through: (i) fair treatment of its employees in full compliance with all applicable laws and regulations; and (ii) supporting community participation and development activities through its CSR program. Involuntary resettlement and indigenous peoples are not relevant issues in the operations of the project owners and are unlikely to become relevant issues in its future operations.

SETs present tremendous environmental benefits when compared to the conventional energy sources. In addition to not exhausting natural resources, their main advantage is, in most cases, total absence of almost any air emissions or waste products. In other words, SE can be considered as an almost absolute clean and safe energy source.

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On the other hand, it must be realized that no manmade project can completely avoid some impact to the environment, so neither can SET installations. Potential environmental burdens depend on the size and nature of the project and are often site-specific. Most of these burdens are associated with loss of amenity (e.g., visual impact or noise in the case of central systems).

However, adverse effects are generally small and can be minimized by appropriate mitigation measures, including the use of the best available abatement technologies.

Technologies or techniques that can be used to eliminate or minimize potential environmental impacts from SETs may involve, in some cases, the use of air emission or odor control equipment, design tools for optimal design and siting of the installations, best practice guidelines, improved pieces of equipment (such as gearless or lubricant-free motors), or completely innovative design (e.g., closed-cycle plants, submerged plants, etc.)

It is up to the involved factors (investors, developers, and permitting authorities) to make the appropriate decisions by taking environmental issues into serious consideration. To that end, an Environmental Impact Assessment for central solar systems, which should estimate the magnitude of potential environmental impacts and propose appropriate mitigation measures, can play a significant role to proper project design and to a subsequent project public acceptance.