At this juncture, we are encountering the worst electricity crises of the history of Pakistan resulting in extended load shedding which virtually impedes our industrial growth and suspends social life. If we see the electricity mix of Pakistan it is heavily tilted towards imported oil. Any oil price hike in the international market will badly impact our electricity generation and the current circular debt issue would become even more critical. Renewable Resources Pvt. Ltd is established in 2009, with an aspiration to promote and facilitate development of renewable energy technologies in Pakistan to achieve energy security.

Today I am proud to say that we have made an impact and the company is involved in the consulting of renewable and indigenous energy projects of more than 900 MWs in Pakistan. This is just the beginning and I wish that in the next few years renewable energy shall get its due share in the electricity mix of Pakistan. BUT wishes can’t make things happen it’s the action. We have taken the first step by providing the quality services to our clients by becoming the One Stop Shop for them.

Our professional and dedicated team is not only providing the consulting services to the investors and developers BUT are also involved with lenders for due diligence of the projects. We are also finding new sites with the potential of Wind, Solar and other Renewable Energy technologies for the development of these indigenous technologies.

To build our capacity and learn the international best practices we partner with Lahmeyer International of Germany - one of the leading international players in the consulting business. In the end I commit that we will continue striving to provide the timely quality services to our clients.

Irfan Afzal Mirza
Chief Executive Officer
MISSION STATEMENT

Our goal is to become the leading consulting firm in Renewable Energy sector in Pakistan as well as internationally by giving our clients timely superior quality services and help them earn the due profits. We also commit to make meaningful contribution to help our country achieve sustainable energy future and to protect the planet Earth now and for generations to come.
REnewable REsources (RE2) provides consultancy services for Renewable Energy and Indigenous Energy projects. The company was incorporated in 2009 and has head office in Islamabad and a branch office in Karachi.

RE2 is a ONE STOP SHOP for the development of renewable energy power projects. RE2 envisages positioning itself among the major energy advisory companies globally, and strives towards creating a cleaner and sustainable future while ensuring its corporate aims substantially contribute towards the additional goal of poverty alleviation.

RE2 provides high quality energy engineering and management consulting services to enable rapid deployment of efficient, cost-effective, reliable, and environment-friendly renewable energy projects. Our customized technical solutions and services are dedicated to investment firms, energy groups, industries, financial institutions and public sector organizations involved in the development and / or acquisition of renewable and indigenous power plants.

RE2 offers services for new “green” business innovation. For time efficient project development; RE2’s range of expertise include resource assessment, power production analysis, selection of technology / power equipment, feasibility studies, financial models, environmental examinations, government approvals, project due diligence, security documents, and supervision and monitoring the EPC and O&M activities etc.

RE2 has licensed versions of globally recognized software for wind and solar computations.

The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of the complete power projects cycle, which enable it to make valuable contributions in getting Generation License, approval of Tariff, and negotiations of Security Documents - Energy Purchase Agreement (EPA) and Implementation Agreement (IA).
RE2’s services employ effective and time efficient practices in project development that are considerate of technical, financial and administrative aspects dictated by each stage of the project. Such practices are vital in power projects in order to identify and save unnecessary and huge overheads during execution.

Our services are designed for private investors, lenders, other financial institutions, EPC contractors, public sector and donor agencies, as well as energy and industrial groups. Our team is composed of the leading experts for each specific energy field.

RE2 is providing services in the following areas:

- Wind Power
- Solar Photovoltaic Power
- Concentrated Solar Power
- Bio Energy – Biomass, Biogas, Bio Diesel
- Geo Thermal Energy
- Coal Power

At a micro level, RE2 offers the following exclusive services for project design, development and implementation:

- Site Facilitation and Acquisition
- Site Investigations
- Handling of Energy Resource Measuring Equipment
- Wind / Solar Resource Assessment
- Power Production Analysis using licensed, internationally acclaimed software
- Noise and Shadow Analysis
- Project Design review including civil, electrical, mechanical design
- Project resource and implementation planning
- Financial Modeling
- Environmental Audits and Social Impact Assessment
- EPA / IA Consultation and Negotiations
- Tariff Application and Defense
- EPC / Construction Supervision
- O&M Supervision
PROJECT DEVELOPMENT CYCLE OF RE PROJECTS

SITE ASSESSMENT
- Site Identification and Technical Viability
- Site Access and Transportation Studies
- Resource Measurement Instruments and Data Collection

PRODUCTION ANALYSIS
- Resource Assessment
- Energy Yield Estimate

TENDERING & PROCUREMENT
- RFP for EPC contract
- EPC offer evaluation and recommendation

STUDIES / APPROVAL / LICENSING
- Feasibility Study
- Technical Due Diligence
- Generation License
- Financial Model and Tariff

EXECUTION
- Construction Supervision
- O&M Supervision

PROJECT DOCUMENTS
- Energy Purchase Agreement (EPA)
- Implementation Agreement (IA)

WIND

SOLAR

COAL

BIOMASS
RE2 is engaged in / has completed several projects of local and international developers. To demonstrate the varied operations at RE2, few case studies are prepared and made part of this profile. A brief list of projects is given below before the case studies:

## WIND POWER

- **THREE GORGES FIRST WIND FARM PAKISTAN (PVT) LTD OWNED BY CHINA THREE GORGES CORPORATION**  
Project Development of **50 MW Wind Power Project** in Jhimpir, Sindh, Pakistan is completed. RE2 is the Project consultant and one stop shop for the sponsors. RE2 has developed the Project from inception. The EPA has been signed. The construction of the Project is in progress and RE2 is providing construction supervision services for Project.

**Milestones Achieved:**
- Technical and Financial Feasibility Study approved from Alternative Energy Development Board (AEDB)
- Electrical and Grid Interconnection Studies approved from National Transmission and Dispatch Company (NTDC)
- Initial Environmental Examination approved from Environment Protection Agency (EPA) Sindh
- Filling and Approval of Tariff and generation License from National Electric Purchase Regulatory Authority (NEPRA)
- Energy Purchase Agreement (EPA) has been signed
- Implementation Agreement (IA) has been signed
- Construction of Project has been completed and project commissioning is in progress

- **UEP WIND POWER PVT. LTD OWNED BY UNITED ENERGY LIMITED PAKISTAN**  
Project Development of **100 MW Wind Power Project** in Jhimpir, Sindh, Pakistan is in process. RE2 is the Project consultant and one stop shop for the sponsors. RE2 has developed the Project from inception. The feasibility of the Project has been submitted to Alternative Energy Development Board (AEDB). The feasibility submitted by RE2 is a complete package including

Milestones Achieved:
- Technical and Financial Feasibility Study submitted to Alternative Energy Development Board (AEDB)
- Electrical and Grid Interconnection Studies submitted to National Transmission and Dispatch Company (NTDC)
- Environmental Impact Assessment (EIA) submitted to Environment Protection Agency (EPA) Sindh Pakistan and approval granted
- Upfront tariff and generation license awarded
- EPA negotiations are in process with NTDC

- **HAWA ENERGY (PVT.) LTD**
Project Development of **50 MW Wind Power Project** in Jhimpir, Sindh, Pakistan is in process. The sponsors are from USA. RE2 is the Owner’s Engineer of the Project. The feasibility of the Project has been submitted to Alternative Energy Development Board (AEDB). The feasibility submitted by RE2 is a complete package including Wind Resource Assessment Report, Energy Report, Transportation and Access Study, Geo-Investigation Report, Environmental Impact Assessment Report and Financial Feasibility. The Project is now at tariff stage. The Project sponsors intend to get the upfront tariff and the Project is expected to achieve financial close in 3rd quarter of 2014. The Board of Directors of OPIC has approved financing of upto USD 100 million for Hawa Energy Project.

Milestones Achieved:
- Technical and Financial Feasibility Study submitted to Alternative Energy Development Board (AEDB)
- Electrical and Grid Interconnection Studies submitted to National Transmission and Dispatch Company (NTDC)
- Environmental Impact Assessment (EIA) submitted to Environment Protection Agency (EPA) Sindh Pakistan
- Upfront tariff application and generation license application awarded by NEPRA
- EPA negotiations are in process with NTDC
- Financing approved by Board of Directors of OPIC
• MASTER WIND ENERGY (PVT.) LTD
RE2 has done the Wind Resource Assessment, Energy Yield Estimate and Review of EPC / O&M Contracts for **50 MW Wind Power Project** in Jhimpir, Sindh, Pakistan, in partnership with Lahmeyer International.

Milestones Achieved:
- Wind Resource Assessment
- Energy Yield Estimates
- Review of EPC /O & M Contracts
- Submission and Approval of Initial Environmental Examination from Environment Protection Agency (EPA) Sindh Pakistan

• FAUJI WIND ENERGY –I (FWE-I) & FAUJI WIND ENERGY –II (FWE-II)
Project Development of **100 MW Wind Power Project** of FWE –I & FWE –II in Gharo, Sindh – Pakistan is completed. The financial close of the Project is going to be achieved by end of year 2012. RE2 with Lahmeyer International (LI) are the owner’s engineer for construction supervision and O & M supervision.

• TAPAL WIND ENERGY (PVT.) LTD
Project Development of **30 MW Wind Power Project** in Jhimpir, Sindh – Pakistan is in process. The feasibility of the Project has been completed. The feasibility submitted by RE2 is a complete package including Wind Resource Assessment Report, Energy Report, Transportation and Access Study, Geo-Investigation Report, Environmental Impact Assessment Report and Financial Feasibility.

Milestones Achieved:
- Wind Resource Assessment
- Energy Yield Estimates
- Initial Environmental Examination (IEE)
- Grid Interconnection Studies
- Submission and Approval of Initial Environmental Examination from Environment Protection Agency (EPA) Sindh Pakistan
- Request for Proposals (RFPs) have been sent to potential EPC contractors and bids are received
Negotiations with the potential EPC contractor is almost finalized
EPA negotiations are at final stage

• PAKISTAN WIND ENERGY GENERATION (PVT) LTD
Project Development of 5 MW Wind Power Project in Jhimpir - Sindh, Pakistan is completed. The feasibility of the project has been submitted to AEDB and the upfront tariff for the Project has been taken in year 2012.

Milestones Achieved:
- Wind Resource Assessment
- Energy Yield Estimates
- Initial Environmental Examination (IEE)
- Grid Interconnection Studies
- Submission and Approval of Initial Environmental Examination from Environment Protection Agency (EPA) Sindh Pakistan
- Filing and Approval of upfront tariff

• NATIONAL BANK OF PAKISTAN
RE2 is the Lender’s Engineer for Fauji Wind Energy 2X50 MW Wind Power Projects (FWE-I & FWE-II) in Gharo, Sindh Pakistan, in partnership with Lahmeyer International. The above services are provided to a consortium of banks including Asian Development Bank (ADB) and Islamic Development Bank (IDB). The financial close of the Project has been achieved and construction has been started. Turbines have been erected and commissioning is in progress.

• HABIB BANK LIMITED OF PAKISTAN
RE2 is Lender’s Engineer for Yunus Energy 50 MW Wind Power Project in Jhimpir, Sindh Pakistan, in partnership with Lahmeyer International. Lender’s Engineer services are provided to a consortium of banks including Habib Bank Limited of Pakistan, United Bank Limited, MCB Bank Limited, Faysal Bank Limited and Allied Bank Limited of Pakistan.

• INTERNATIONAL FINANCE CORPORATION (IFC)
RE2 is Lender’s Engineer for Zorlu Energy 50 MW Wind Power Project in Jhimpir, Sindh, Pakistan, in partnership with Lahmeyer International. Lender’s Engineer services are provided
to a consortium of banks including IFC, Asian Development Bank (ADB) and Habib Bank Limited of Pakistan. The erection and commissioning of the turbines has been completed. Project is operational.

- **NATIONAL BANK LIMITED OF PAKISTAN**
  RE2 has provided due diligence services for feasibility and EPC Contract as Owner’s Engineer for Tapal Wind Energy 30 MW Wind Power Project in Jhimpir, Sindh Pakistan, in partnership with Lahmeyer International. The services are provided to National Bank of Pakistan.

- **CONSTRUCTION SUPERVISION OF 30 MW WIND POWER PROJECT OF TAPAL WIND**
  RE2 is providing construction supervision services as lender’s Engineer for Tapal Energy 30 MW Wind Power Project in Jhimpir, Sindh Pakistan, in partnership with Lahmeyer International. The services are provided to National Bank of Pakistan.

- **INTERNATIONAL FINANCE CORPORATION (IFC)**
  RE2 has provided due diligence services as lender’s Engineer for Metro Power 50 MW Wind Power Project in Jhimpir, Sindh Pakistan, in partnership with Lahmeyer International. The services are provided to IFC.

- **CONSTRUCTION SUPERVISION OF 50 MW WIND POWER PROJECT OF METRO POWER**
  RE2 is providing construction supervision services as lender’s Engineer for Metro Power 50 MW Wind Power Project in Jhimpir, Sindh Pakistan, in partnership with Lahmeyer International. The services are provided to IFC.
SOLAR POWER

- **ROSHAN POWER (Pvt) LTD OWNED BY BEACONHOUSE GROUP**
  Project Development of **10 MW Solar PV Power Project** in Kasur, Punjab, Pakistan is in process. The feasibility of the Project is submitted and approved from Punjab Power Development Board (PPDB). The project is has applied for upfront tariff and Generation License application to NEPRA.

  **Milestones Achieved:**
  - Solar Resource Assessment
  - Energy Yield Estimates
  - Initial Environmental Examination (IEE)
  - Grid Interconnection Studies
  - Approval of Feasibility studies from PPDB
  - Submission and Approval of Initial Environmental Examination (IEE) from Environment Protection Agency (EPA) Sindh Pakistan
  - Submission of Upfront Tariff application and Generation License application to NEPRA

- **FIRST SOLAR (Pvt.) LTD**
  Project Development of **2 MW Solar PV Power Project** in Kallar Kahar, Punjab, Pakistan is in process. The feasibility of the project is submitted to AEDB.

  **Milestones Achieved:**
  - Solar Resource Assessment
  - Energy Yield Estimates
  - Initial Environmental Examination (IEE)
  - Grid Interconnection Studies
  - Submission and Approval of Initial Environmental Examination (IEE) from Environment Protection Agency (EPA) Sindh Pakistan
  - Tariff application filed in NEPRA
• **JK POWER (Pvt) LTD OWNED BY JK SPINNING MILLS LIMITED**
  Project Development of **10 MW Solar PV Power Project** in Faisalabad, Punjab, Pakistan is in process. The company has recently got LOI from Punjab Power Development Board. The feasibility of the Project is in progress.

• **HANERGY GLOBAL SOLAR ASIA PACIFIC LIMITED, CHINA**
  Project Development of **10 MW Solar PV Power Project** in Pind Dadan Khan Punjab in Pakistan is in Progress. The company has recently got LOI from Alternative Energy Development Board. The land of the project is almost finalized and feasibility of the projects is in progress.

• **HANERGY GLOBAL SOLAR ASIA PACIFIC LIMITED, CHINA**
  Project Development of **50MW Solar PV Power Project** in Pind Dadan Khan Punjab in Pakistan is in Progress. The company has recently got LOI from Alternative Energy Development Board. Land selection is in progress.
**THERMAL POWER**

- **MALAKWAL POWER (PVT.) LTD OWNED BY BEACONHOUSE GROUP**
  
  Project Development of **50 MW Coal Power Project** in, Punjab, Pakistan is in process. The feasibility of the Project has been approved. It is a kind of first bankable feasibility of coal power project in Punjab. The Project is now at tariff stage.

**Milestones Achieved:**
- Site Selection
- Process flow and Quantity Estimation
- Grid Interconnection Studies
- Geotechnical Investigation
- Submission and Approval of Initial Environmental Examination (IEE) from Environment Protection Agency (EPA) Sindh Pakistan

- **DUE DILIGENCE OF 120 MW BIOMASS POWER PROJECT OF FATIMA ENERGY LIMITED**

  RE2 is Lender’s Engineer for Fatima Energy **120 MW Biomass Project** at Mehmoodkot Muzaffargarh in partnership with Lahmeyer International. Lender’s Engineer services are provided to **Habib Bank Limited of Pakistan**.

- **CONSTRUCTION SUPERVISION SERVICES OF 120 MW BIOMASS POWER PROJECT OF FATIMA ENERGY LIMITED**

  RE2 is providing Construction Supervision services as Lender’s Engineer for Fatima Energy 120 MW Biomass Project at Mehmoodkot Muzaffargarh in partnership with Lahmeyer International. Lender’s Engineer services are provided to Habib Bank Limited of Pakistan.

**BIOMASS:**

**PROMOTING SUSTAINABLE ENERGY PRODUCTION AND USE OF BIOMASS IN PAKISTAN – A PROJECT OF WINROCK / UNIDO.**
During this project, various biomass resources were analyzed and validated for possible technological options for making sustainable use of existing biomass resources. The major output of the project was the development of three pre-feasibilities for pilot projects, two for SMEs and one for village electrification was designed with costs, associated income generation activities, co-financing, GHG emissions reduction, monitoring and evaluation plans etc.

15 MW HIGH PRESSURE BAGGASE BASED POWER GENERATION PROJECT OF HAMZA SUGAR MILLS LIMITED

Hamza Sugar Mills Limited got LOI in September 2013 for the development of 15 MW high pressure based power generation Project at Jhetta Bhutta Khanpur, District Rahimyar Khan. RE2 is the project consultant for the development of the Project. The initial Environmental Examination of the project has been submitted to EPA Punjab. Generation License and Upfront Tariff application shall be submitted in the first quarter of 2014. The Project is expected to achieve financial close by 3rd quarter of 2014.

OTHERS

- Development of Micro Finance System for MFIs / DFIs to support Off-Grid Solar PV Applications – A Project of GTZ.
- Development of microfinance schemes for solar households in Pakistan – A Project of ENERCON
- Feasibility of Cultivation and Production of Biodiesel in Cholistan Punjab Pakistan-A Project of DACC Power Generation Company Pvt. Limited
Lahmeyer International GmbH (LI) is amongst the world leaders in technical consulting for Infrastructure Project with over 40 years experience and expertise in multi-disciplinary/technology planning and engineering services. The company was established in 1966 and now has a talent based comprised of engineers, natural scientists and economic experts from over 30 disciplines, combined with the state-of-art-tools and technologies, in the same tradition of those pioneers. With Project experience in over 35 countries, LI’s has a work force of over 1,000 professionals and an annual turnover of more than EUR 100 million.

The company offers a wide spectrum of independent technical and economic planning and consulting services in the sectors of energy, hydropower and water resources. The focus is value engineering and economic efficiency, with the highest priority being given to environmental compatibility, social accept-ability and conservation of resources.

In the wind sector, the key references are; country wide wind mapping of 13 countries, wind potential evaluation of 405 farms, feasibility studies of 150 wind farms (5,540 MW), due diligence of 745 farms (18,800 MW), construction supervision of 75 farms (1,920 MW) and O&M supervision of 90 farms (2,500 MW).
The Team

Irfan Afzal Mirza, CEO:

Mr. Mirza has more than 15 years of work experience and is the pioneer of the MW class wind energy program in Pakistan. He served as a core team member in laying the foundation of Alternative Energy Development Board (AEDB), the apex Government of Pakistan body governing renewable energy projects in the country.

He has been the key architect of first renewable energy power policy of Pakistan and made the valuable contributions in developing the first Energy Purchase Agreement for wind power in Pakistan by changing the demand driven concept to supply driven concept. He also initiated the requirement of changing the grid codes for wind energy in Pakistan and has the honor of giving the first presentation to the authorities. He has many research publications published in international journals like the ELSEVIER Journal of Renewable Energy.

He is actively involved in World Wind Energy Association (WWEA) to promote wind energy in the world. He participated as speaker in many international conferences including as one the speakers from Asia in WWEA International Conference in Husum, Germany in 2010.

He remained involved in the inception activities of International Renewable Energy Agency (IRENA) at the inception conference at Germany.

As CEO/Director of RE2, he is leading and managing the overall vision of the company and providing strategic direction to achieve company’s ultimate goals.

M. Ammad Riaz, Head of Operations and Projects:

Mr. Riaz brings skills including engineering management, system design & development, project planning & management, market & business analysis, financial modeling etc.

He has been the pioneer in implementation of solar energy applications in the telecom sector for captive power. He has also been a part of the team making vital contributions in the bio diesel and fuel ethanol programs in Pakistan.

As Head of Operations and Projects of RE2, he is looking after the company operations, execution of projects, coordination with clients and progress monitoring.
Salman Nazir, Manager, Projects:

Mr. Nazir is a Mechanical Engineer with experience of more than 5 years in the field of RE sector.

His contributions to the company include expertise in simulation software (such as WAsP, WinPro, Windographer, Homer, Google Professional Tools and integrated use of different software etc.) and in making technical feasibilities. This makes him one of the very few in the country to have capabilities of assessing the potential of an RE project at any site.

Mr. Nazir has vast knowledge of Solar PV system design and installation including off grid, hybrid and grid connected systems.

Mr. Nazir is also an expert of site identification, access studies, supply chain strategies, logistics plans etc.

Humayun Azad, Manager, Projects:

Mr. Azad holds a Bachelor’s degree in Electrical Engineering degree from Carleton University, Canada, and a Master’s Degree in Electrical Engineering from Malaysia. He is an expert of internal interface of the power plants and their grid interconnection; particularly for renewable energy based power plants. He has the experience of working in the first ever 6 MW Wind Farm in Pakistan.

His contributions to the firm include performing technical evaluation of on-grid wind power projects, leading Electrical Engineering specific tasks in project development, technical due diligence, construction supervision (installation, testing and commissioning of power plants), O&M supervision assignments and Electrical Engineering aspects of the Energy Purchase Agreement.

Sana Ahmed, Manager, Projects:

Ms. Ahmed holds a Masters degree in Environmental Sciences.

Ms. Ahmed’s knowledge and experience is valuable in identifying and completing the environmental assessments of power projects, developing proposals, compiling reports and rendering support role in other development activities.

She also brings expertise in documentation of Quality Management System (QMS) and Project Documentation.

Samia Amin, Head of Administration and Finance:

Ms. Amin holds CA Foundation and MBA qualifications. She looks after the overall financial system of the company, asset management, cash flow management, budgetary analysis etc. She also coordinate with the company management in day to day administrative work.
In early 2010, Three Gorges First Wind Farm Pakistan Pvt) Ltd – a company owned by China Three Gorges Corporation (CTGC) acquired the services of Renewable Resources (Pvt) Ltd (RE2), for the development of their first of the few planned power projects in Pakistan. The project is of 50 MW capacity and is located in Jhimpir, Sindh.

The range of services provided by RE2 included development of feasibility study, tariff preparation & defense at NEPRA, development of EPC / O&M contracts, and deep consultation on EPA & IA and other licensing and permits. A brief introduction of sponsors and extracts of RE2’s rendered services is provided here:

**China Three Gorges Corporation**

Renowned for the construction and operation of the Three Gorges Dam, currently the largest power station in the world, The China Three Gorges Corporation’s portfolio includes:

- Three Gorges Dam with an installed capacity of 20,300 MW
- Malaysia Muruo hydropower station with an installed capacity of 944 MW
- Sudan Atbara hydropower project, currently under construction with a capacity of 150 MW

**PROJECT CASE STUDIES**

**PROJECT DEVELOPMENT FOR THREE GORGES WIND FARM**

Spanning 1.1 km over the Yangtze River, in Hubei province, China, The Three Gorges Dam was commissioned in 2008. With installed capacity of 20,300 MW, the project houses a total of 31 turbines. The construction cost is estimated around US$26 billion.

With 193.5 MW of wind projects in operation and 250 MW under construction in China, in pursuit of their overseas business objectives, CTGC established Three Gorges First Wind Farm (Pvt.) Ltd. (TGF), with the goal of establishing the first 50 MW of their envisioned 1000 MW of wind power in Pakistan. Ground Breaking of the first 50 MW was held on December 30th, 2011.
Following the awarding of the Letter of Intent (LOI) from the AEDB, TGF acquired the services of RE2 for the feasibility of their first 50 MW wind power project in Pakistan. Factors examined under the feasibility included:

  Verification of the accuracy of the wind data and its analysis to determine Gross energy estimates of the project. Wind farm losses such as electrical losses, wake losses and uncertainties related measurement instruments and modeling errors accounted for in deriving net energy estimates verified by RE2 wind experts.

- **Feasibility of grid interconnection**
  Results of Electrical Grid Interconnection study assessed against NEPRA’s grid code addendum for wind power plants. Electrical and Grid Interconnection study includes Load Flow Analysis, Short Circuit Analysis, Power Quality and Power Evacuation. Results of load flow studies analyzed to determine requirements for grid connection apparatus such power transformers and protection systems.

- **Findings of Geotechnical Investigation**
  Field and Laboratory testing of soil and investigation of sub-soil conditions incorporated in the recommendation of wind turbine foundation such as cement and free water content of concrete.

- **Initial Environment Examination (IEE)**
  IEE carried out to determine any potentially adverse environmental effects, and applicable mitigation measured. IEE governed by requirements of the Environmental Protection Agency, Government of Sindh.

- **Financial feasibility**
  A complete financial model of the project was developed. It included analysis of project development, operation and maintenance, and debt scheduling performed and tariff for the project determined for filing of tariff petition.

The feasibility study was submitted to AEDB in December 2010, and approval was granted in May 2011, thus paving the way for the negotiation of project documents and tariff petition.
Prior to financial close, the Energy Purchase Agreement (EPA) and Implementation Agreement (IA) must be initialed between the Project Company and Power Purchaser, and between the Project Company and AEDB, respectively. Collectively, these agreements cover:

- Procedures to identify the actual net delivered energy and the possible energy considering the resource and grid variability.
- Terms and condition of Energy payments to be made to project company
- Procedures to be followed by project company during construction and operation and maintenance phases of the project
- Guarantees by the power purchaser for transmission of power from project to grid
- Securities and safe guard measures against political uncertainties, law and order issues and natural disasters
- Support of Government of Pakistan in obtaining various consents required for the project.

For finalizing the various technical and legal aspects of the energy purchase agreement, TGF was consulted by RE2. Grid compliance requirements were fulfilled while keeping into account project cost, and project delivery time.

With the involvement of RE2’s technical team, negotiations on EPA clauses were concluded in a period of just four months.

Parallel negotiations and discussion between TGF and AEDB on the Implementation Agreement positively influenced TGF’s project development cost and time.

With the 50 MW TGF project entering construction phase, RE2’s services have been retained by TGF for project construction supervision. With the introduction of Upfront Tariff in Pakistan, RE2 is consulting CTGC on EPA and IA incorporating the upfront tariff for their future projects in Pakistan as well.
Technical Due Diligence services by Renewable Resources (Pvt.) Ltd in collaboration with Lahmeyer International were provided for the two Fauji Wind Energy (FWE) Wind Power Projects each of 50 MW capacity. Tasks ranging from review of all project documents to the site surveying were performed. Issues related to performance guarantees, power plant equipment’s non-compliance with the grid code, errors and omissions in the Wind Resource Assessment (WRA) and Energy Estimates, through early identification resulted in better risk assessment for the lenders and reduced costs for the project sponsors. RE2 made valuable contributions in creating a bridge between EPC / O&M contracts and the EPA.

Safeguarding Wind Farm Investment through Independent Review and Inspection

To safeguard investments in wind power projects and assure quality in project delivery, project owners, investors, lenders and insurance companies rely on independent review and inspection to verify that the proposed wind power project will perform as per feasibility documents and in compliance with the applicable grid requirements.

Located in the coastal region of Gharo, Sindh, the FWE wind power projects totaling 100 MW shall consist of 40 Nordex N100 turbines each with a capacity of 2.5 MW and generate a total of approx 275 GWh annually.

Technical Due Diligence by Renewable Resources (Pvt.) Ltd and Lahmeyer International

In 2011, Renewable Resources (Pvt.) Ltd in collaboration with Lahmeyer International performed Technical Due Diligence of the Foundation Wind Energy wind power projects for the project lender, The National Bank of Pakistan.

Project Documents and reports comprising of Energy Purchase Agreement (EPA), Wind Resource Assessment (WRA), Energy Yield Estimates and Electrical Designs were reviewed. With the project being a first of its kind for the lenders, the outcome of the document review added value in the risk analysis.
Issues were reported and were then resolved in close coordination with the Owner’s Engineer and the Project Consultants. Lenders raised their many concerns through specially made templates, conference calls and review meetings to remove any doubts arising in their minds after their own review of documents. The presence of RE2 / LI removed/clarified all risk factors and associated fears. The advice was given on pure professional grounds and merit.

Construction and O&M Supervision
With the project nearing Financial Close, The National Bank of Pakistan has engaged RE2 for the construction and 5 years of O&M supervision.

Through the collaboration with LI, RE2’s services will be backed by LI’s 1900 MW of construction supervision experience, and over 2500 MW of O&M experience.
WIND RESOURCE ASSESSMENT

Wind Resource Assessment is a process of estimating wind potential in the region and predicting expected energy yield of a wind farm. These studies are required for the project feasibility and lending facility. Renewable Resources (RE2) has strong expertise to use Wind Atlas Simulation Program (WAsP) for resource assessment studies.

RE2 is competent and equipped to perform Ariel survey for the selection of potential regions, thereafter, selection of land and supervising the commissioning and monitoring of resource measurement equipment.

Data Processing:

Correct data acquisition is strength of an accurate wind resource assessment and thus the complete project feasibility. RE2 extends its services to clients with its dedicated experts who monitor wind data and suggest corrective and preventive maintenance of equipment. RE2 uses Windographer which is an advanced tool for deep analysis of wind dataset, data treatment and fault investigations. The end result is the monthly mean of wind speed and the analysis of wind direction. The wind frequency distribution with respect to occurrence, direction and the energy potential is assessed.
RE2 provides the services for the selection of exact best location for the installation of wind measuring mast as per international standards and best practices. RE2 also provides the supervision services for the installation and commissioning of the masts to ensure that the data collected shall be bankable. In addition to that RE2 provides the data management services to ensure the quality of data.

**Farm Layout:**

Micrositing of wind turbines involves vigilant contemplation of aspects related to wind flow, topography (site contour), equipment access, transmission lines, environmental considerations, land-use issues and visual impact. At the same time impact of wind disturbance by another turbine, man-made constructions, vegetation and site specific subjects are also taken into account. Based on it, the most optimum farm layout with maximum efficiency is designed.

**Energy Predictions:**

Using the results of resources assessment and against the planned farm layout, the gross energy yields are predicted in software models using the specifications of the wind turbines. Afterwards, all possible losses and corrections are applied including the availability of system, the temperature effects, electrical losses within the system, availability of utility grid etc. The end result is a predicted annual net energy yield value.

**Uncertainty Analysis:**

Uncertainty analysis is performed for better confidence of sponsor and lender. The wind studies are based on predictions from history with an expectation that the prediction shall turn to reality. The uncertainty analysis involves assigning certain probability to various factors and then deriving “safe predictions” by using statistical tools. RE2 holds strong expertise for investigating the uncertainty of variables.
Sun Resource Assessment is process of estimating sun potential in a region and to predict expected energy yield of a solar farm required for the project feasibility and lenders. Renewable Resources (RE2) has strong expertise to run site specific sun simulation for resource assessment studies.

RE2 is competent and equipped to perform Ariel survey for the selection of potential regions, thereafter, selection of land and supervising the commissioning and monitoring of resource measurement equipment.

**Data Processing:**

RE2 uses various factors involved in the analysis of solar irradiation including the clearness of radiations, dust, fog, clouds, temperature etc. Based on the observations, a tilt angle for the solar array is calculated for maximum energy predictions. All simulations are made in internationally recognized software tools. The end result is month wise affective irradiance per m² leading a value for the whole year.
**Farm Layout:**

Solar farm layout design plays a critical role in the output of the array. Proper layout designing considers spacing between arrays, shadow analysis, two axis orientation and equipment access to acquire maximum sun energy. The optimum spacing should be calculated to make minimum usage of the land resource and still creating no shadow on the arrays at any time. RE2 uses computer aided design and advance planning & design simulation programs to calculate the optimum land requirement. Also, orientation and slope are calculated based on the site specific latitude, evaluating optimum annual sun path for maximum annual energy production.

**Energy Predictions:**

Using the results of resources assessment and against the planned farm layout, the gross energy yields are predicted in software models using the specifications of solar modules. Afterwards, all possible losses and corrections are applied including the availability of system, the temperature effects, electrical losses within the system, availability of utility grid etc. The end result is a predicted annual net energy yield value.

**Uncertainty Analysis:**

Uncertainty analysis is performed for better confidence of sponsor and lender. The wind studies are based on predictions from history with an expectation that the prediction shall turn to reality. The uncertainty analysis involves assigning certain probability to various factors and then deriving “safe predictions” by using statistical tools. RE2 holds strong expertise for investigating the uncertainty of variables.
Environmental studies (EIA/IEE) is required to conduct for every development project as per Pakistan Environmental Protection Act, 1997.

RE2 has gained a significant experience in conducting Environmental and Social Impact Assessments (ESIA), Initial Environmental Examination (IEE) of renewable energy projects in accordance to national and international laws. The study covers all the baseline environmental conditions and anticipated environmental impacts of the project.

RE2 will identify project stakeholders and hold consultations with them to delineate the appropriate boundaries of the environmental assessment and to screen potential adverse environmental and social issues. A comprehensive environmental management and monitoring plan is provided to ensure the adequacy and effectiveness of the proposed management by clearly identifying the roles and responsibilities of the contractor, supervisory consultant and the client.

RE2 use special computer aided software for shadow analysis and noise analysis for wind power project.

So far, RE2 has conducted following Environmental studies of renewable energy projects which have been approved from the concerned Environmental Protection Agencies. It is worth noted that RE2 takes the responsibility of the approval of the studies.

- IEE of 50 MW Wind Power Project of Master Energy Pvt. Ltd in Jhimpir
- IEE of 50 MW Wind Power Project of Three Gorges First Wind Farm Pakistan (Pvt.) Ltd in Jhimpir
- IEE of 50 MW Wind Power project of Zephyr Power (Pvt.) Ltd in Gharo
- IEE of 50 MW Wind Power Project of New Park Energy (Pvt.) Ltd in Gharo
- IEE of 42 MW Wind Power project of DHA City Karachi
- IEE of 05 MW Wind Power Project of Pakistan Wind Energy Generation (Pvt.) Ltd in Jhimpir
- EIA of 50 MW Wind Power Project of Hawa Energy Pvt. Ltd
- EIA of 100 MW Wind Power Project of UEP Wind Power Pvt. Ltd
- IEE of 2 X 50 MW Wind Power Project of Wind Eagle-1 & Wind Eagle-2
- IEE of 30 MW Wind Power Project of Tapal Wind Pvt. Ltd
- IEE of 2 x 5 MW Solar Power Project of TechAccess FZE L.L.C in Pind Dadan Khan
- IEE of 02 MW Solar PV Power project of First Solar Pvt. Ltd in Kalar Khar, Punjab
- IEE of 50 MW Solar power Project of DACC Power Generation Company Limited
- IEE of 10 MW Solar Power Project of Roshan Power Pvt. Ltd in Kasur Punjab Pakistan
- IEE of 50 MW Coal Power Project of Malakwal Power in Punjab Pakistan
- IEE of 15 MW Bagasse based Power project of Hamza Sugar Mills Limited
RE2 provides professional construction supervision services specifically designed to safeguard the successful completion of project.

Our Construction supervision services include:

- Supervision of construction, erection and commissioning
- Review of construction schedules and monitoring sites
- Advising the client regarding
- Review of EPC contractor work plan
- Preparation of monthly site progress reports
- Monitor Health and Safety aspect
- Commissioning and Testing
- Quick Response Facility (QRF)
- Project Coordination Support
- Budget Monitoring

RE2 is having the contracts for the construction supervision of following renewable energy projects;

- 50 MW Wind Power Project of Foundation Wind Energy-I (FWE-I) in Gharo, Sindh-As Lenders Engineer with Lahmeyer International

- 50 MW Wind Power Project of Foundation Wind Energy-I (FWE-II) in Gharo, Sindh-As Lenders Engineer with Lahmeyer International

- 50 MW Wind Power Project of Fauji Fertilizer Company Limited- As Owner’s Engineer with Lahmeyer International as Owner’s Engineer

- 30 MW Wind Energy Project of Tapal Wind (Pvt.) Ltd- As Owner’s Engineer

- 10 MW Solar PV Power Project of Roshan Power (Pvt.) Ltd owned by Beaconhouse Group- As Owner’s Engineer
O & M SUPERVISION

During the operation phase of the wind farms our role is to verify that the wind farms are working in accordance with the definitions of the WTG supply contract, the corresponding Wind Turbine Warranty and Operation and Maintenance Agreement.

Our services for O & M includes;

- The operation of the wind farms is permanently monitored on a daily basis and monthly O&M report incl. service reports have been generated
- Finding the shortcomings
- Verification that the guaranteed performance and technical availability values are achieved
- Review of the payments including Non-Project Missed Volume (NPMV) payments
- Review of the calculations for shortfall, bonus and NPMV as per the Energy Purchase Agreement
- Monitor that safeguard requirements are in place

RE2 is having the contracts for the O & M supervision of following renewable energy projects;

- 50 MW Wind Power Project of Foundation Wind Energy-I (FWE-I) in Gharo, Sindh-As Lenders Engineer with Lahmeyer International
- 50 MW Wind Power Project of Foundation Wind Energy-I (FWE-II) in Gharo, Sindh-As Lenders Engineer with Lahmeyer International
- 50 MW Wind Power Project of Fauji Fertilizer Company Limited-As Owner’s Engineer with Lahmeyer International as Owner’s Engineer
- 10 MW Wind Energy Project of Tapal Wind (Pvt.) Ltd-As Owner’s Engineer
- 10 MW Solar PV Power Project of Roshan Power (Pvt.) Ltd owned by Beaconhouse Group- As Owner’s Engineer
Renewable Resources (Pvt.) Ltd

Islamabad Office
7, Street No. 48,
Sector F-7/4
Islamabad-44000, Pakistan
Ph: +92-51-8358591
Fax: +92-51-8358592

Karachi Office
1 A, Sea View Apartments
Phase V, DHA Ext.
Karachi, Pakistan
Ph: +92-21-35347122
Fax: +92-21-35347123

www.renewableresources.com.pk