Terms of Reference

Title:	Feasibility Study "Research of the existing potential of a flexible capacity and their involvement in the energy balance by unifying the Western Zone with the Unified Electric Power System of the Republic of Kazakhstan, considering the integration of renewable energy facilities into the grid."
Place of work:	Home-based
Period:	October 2021 - March 2022 (6 months after signing the contract)
Contract type:	Contract for the provision of services of the UNDP format, (procurement at the local level, as well as not limiting international suppliers)
Name of Project*:*	00101058 UNDP/GEF Project "De-risking renewable energy investments"

Description of the project

The objective of the DREI Project is to promote private sector investment in renewable energy sources in Kazakhstan to achieve the country's 2030 and 2050 renewable energy targets. The Project targets both large-scale and small-scale renewable energy sources.

The goal of the DREI Project is to achieve transformation of the energy market in Kazakhstan by significantly increasing the scale of the use of renewable energy sources in electricity production, thereby increasing the share of renewable energy in the country power generation mix from 1.1% in 2017 to 10% by 2030.

To achieve its objective, the DREI Project includes activities to support renewable energy projects that are expected to bring about collective GHG emission reductions of at least 460,000 tonnes of CO2. In addition, by the end of the DREI Project, the Project would have supported the commissioning of 9.5 MW of direct, small-scale renewable energy systems (RES) that will produce about 500 GWh of electrical energy. In regards to the DREI Project, the RE-based power generation units that would be covered are the ones with a capacity below 3 MW. The massive integration of such units (e.g., small-scale solar PV power plants) into the power grid can create grid instability problems.

The project is comprised of three components:

- Component 1 – Large-Scale Renewable Energy: Policy and Financial Derisking Measures
- Component 2 – Renewable Energy for Life: Policy Derisking
- Component 3 – Renewable Energy for Life: Financial Derisking and Incentives

This TOR is prepared within the framework of Activity 1.1.5 under Component 1 - Output 1.1 of the DREI Project. The proposed consultancy assignment will address risks associated with the integration of RE-based power generation units (small scale or large scale) into the grid: *"Develop approaches and recommendations on the participation of conventional power producers in the renewable energy*

market", under Component 1 - Output 1.1 of the DREI project. Per the DREI Project Document, Output 1.1 is *"Technical, economic, financial, environmental and social analysis carried out to support the Ministry of Energy and other stakeholders in the design and implementation of appropriate policies, programmes, and regulations, including the development of briefings for decision-makers"*. The results of this consultancy assignment are expected to be used for reinforcing the formulation of pertinent policies and regulations that will enable the cost-effective and safe integration of flexible power generation facilities into the Kazakhstani electric power system.

Prerequisites for work:

In the existing structure of generating capacities of the Unified Electric Power System of the Republic of Kazakhstan (UES), the dominant position is occupied by thermal power plants (mainly condensing power plants and coal-fired combined heat and power plants), which are baseload power plants.

Currently, several problems are noted in the generation sector of the Republic of Kazakhstan, which are common for all types of power stations, among which there is an acute shortage of reserve and flexible load-following capacities, the coverage of which is provided by the power systems of neighboring countries through the available power lines.

This problem is further aggravated by the introduction of unstable renewable energy sources - wind and solar power plants, the installed capacity of which will grow steadily in the near future. At a high level, new country targets were announced to achieve 15% of electricity generation from renewable energy sources by 2030, and in the future, until 2060, the Republic of Kazakhstan plans to achieve carbon neutrality.

As one of the possible solutions to the problem of lack of flexible capacities, the involvement of power plants of the Western zone, operating on natural gas, in the energy balance of the Republic of Kazakhstan can be considered. However, this requires solving several organizational, legal, and market issues, as well as ensuring the availability of the necessary power grid infrastructure.

Traditionally, four regions were belonging to the Western Zone (West Kazakhstan, Atyrau, Mangistau, and Aktobe) due to their geographical location. Since 2009, after the connection of the electric networks of the Aktobe region to the UES of Kazakhstan (commissioning of the 500 kV overhead line Zhitikara - Ulke), three regions remained in the Western Zone, united by long single-circuit 220 kV power transmission lines, which do not have direct electrical connections with the UES of Kazakhstan and operate in parallel through the grids of the united power system of the Middle Volga and the Urals (Russian Federation).

In recent years, significant changes have taken place in the Western Zone, namely:

- implementation by KEGOC of an investment project to strengthen the 220 kV electrical network in the Western Zone with the construction of a new 220 kV system outdoor switchgear at the Atyrau power center;
- systemic accidents that took place in 2020 with the split of the power system of the Western Zone into parts, and a large-scale shut down in winter, 2020, for the most consumers, including prioritized category consumers, which should not be shut down;
- changes in the structure of power consumption and redistribution of load centers across power centers;
- the development of large oil and gas production complexes (e.g., commissioning of the large Kashagan oil field and the expansion of production at the Tengiz field) with some lagging behind previously outlined plans; the construction of gas and oil pipelines;

- start of petrochemical processing at the Atyrau integrated gas chemical complex with the construction of its own gas turbine power plant;
- commissioning of new gas-fired power generation plants (e.g., gas turbine power plants-200 in Uralsk, expansion of Zhanazhol gas turbine power plants) with the consequential problem of locked capacity due to network restrictions and fuel supply;

Also, the issues of power supply in the Western Zone are affected by the uncertainty of the timing of the previously planned electrification of railway sections (Kandyagash - Makat and Altynsarino - Khromtau) and the emerging trend of commissioning distributed generation (small gas piston power plants in the West Kazakhstan, Atyrau and Mangistau regions, renewable energy sources of low power).

In addition, it is also necessary to assess the prospects for the use of energy storage systems in the Republic of Kazakhstan. On the one hand, as noted earlier, there is a growing need for solutions that can quickly respond to the volatile nature of wind and solar generation, and on the other hand, there is a clear trend of continuing to reduce the cost of energy storage systems.

It is necessary to evaluate the potential solutions for reducing the risk of the energy system/ electricity transmission; the existing technical restrictions on the integration of renewable energy sources into the grid; and the lack of flexible sources of generation in the UES of Kazakhstan, as well as the assessment of the potential for reducing risk in the energy system by the involvement of gas power plants in the Western Region in the country's national energy balance.

Purpose of work:

- Assessment of national electricity balance and electricity generation capacity for the UES of Kazakhstan and the Western Zone (separate and integrated); including the assessment of the available capacities of natural gas-fired generating sources, and their possible involvement in the national energy balance, for the stable operation of the energy system as a whole, taking into account the 15% RE-based electricity generation by 2030 target of the country.
- Assessment of the technical and economic feasibility of power grid construction within the framework of the unification of the energy system of Western Kazakhstan with the UES of Kazakhstan.
- Assessment of the prospects for the use of energy storage systems to balance the UES of Kazakhstan.

Content and scope of work:

1. ANALYSIS OF THE PERFORMANCE INDICATORS FOR POWER SYSTEM OPERATION OF THE REPUBLIC OF KAZAKHSTAN

1.1. Electricity demand (peak, average, and base), electricity generation, electricity sales (distribution per consumer type), electricity load, and demand curves.
1.2. Installed power generating capacities (distribution by technology and fuel used), annual electricity production, station use.
1.3. The balance of electricity demand and available electricity generation capacity in the electricity system of the Republic of Kazakhstan and by zones.
1.4. Assessment of the main indicators of the operation of power grids/networks, including transmission and distribution losses.
1.5. Analysis of existing problems, identification of bottlenecks, and possible solutions.

2. ANALYSIS AND ASSESSMENT OF THE EXISTING STATE OF THE ELECTRICITY SYSTEM IN THE WESTERN ZONE AND ADJACENT REGIONS OF THE UES OF KAZAKHSTAN.

2.1. Regional electricity and power generating capacities balance by each oblast: West Kazakhstan, Atyrau, and Mangystau;
2.2. Large consumers (electricity demand, electricity consumption).
2.3. Generating capacity (installed / available capacity, technical condition - capacity limitations, reserves).
2.4. Grid's conditions;

3. PROSPECTS FOR DEVELOPMENT OF THE WESTERN ZONE AND ADJACENT REGIONS OF THE UES OF KAZAKHSTAN.

3.1. Large electricity consumers planned for commissioning (commissioning terms, electrical load, electricity consumption).
3.2. Development of new power generation capacities, including those based on renewable energy sources (commissioning dates, installed / available capacity, reserves).
3.3. Forecast of electricity demand and installed power generation capacity (supply) up to 2035

4. RESEARCH ON TECHNOLOGICAL POSSIBILITY AND PERFORMANCE OF ELECTRIC GRID CONSTRUCTION WITHIN THE FRAMEWORK OF UNIFYING THE POWER SYSTEM OF WESTERN KAZAKHSTAN WITH THE UES OF KAZAKHSTAN.

4.1. Analysis of the technical and economic feasibility of various options for unifying the electricity system of Western Kazakhstan with the UES of Kazakhstan.
4.2. Calculations of the transmission capacity of electrical networks and flow distribution and voltage levels for the options under consideration.
4.3. Assessment of the impacts of power grid integration and interconnection (system-wide effect, electrification of infrastructure, involvement of additional consumers/generation in the electricity balance), particularly the of renewable energy-based power generation systems).
4.4. Based on the results of the analyses, recommend the most appropriate option(s), including the requirements, and the capacities of the future power grid constructions until 2030-2035.

5. BASIC ELECTRICAL SYSTEM DESIGN CALCULATIONS FOR RECOMMENDED OPTIONS OF ELECTRIC GRID CONSTRUCTION.
5.1. Perform calculations related to system static and dynamic stability to determine the maximum and emergency allowable flows during normal operating and repair/maintenance conditions.
5.2. Preliminary justification of the need, installation sites, capacity, and type of reactive power compensation devices that have to be installed.
5.3. Perform calculations related to assessing the possibility of switching on the overhead line at idle in the summer minimum load mode, as well as determining the possibility of switching on the lines according to the permissible voltage difference between the buses of the substation and the idle end of the switched-on overhead line;
5.4. Perform calculations related to electricity losses and assess their impact on the choice of the recommended option for power grid construction, taking into account the possible construction and connection of renewable energy power plants along the overhead lines;
5.5. Conduct a basic calculation of the cost for the recommended options of electric grid construction, taking into account the costs of protection, monitoring, and control systems.

6. PROSPECTS FOR THE USE OF ENERGY STORAGE SYSTEMS IN THE REPUBLIC OF KAZAKHSTAN.

6.1. Determination of the intended use of energy storage systems as part of the UES of the Republic of Kazakhstan.
6.2. Assessment of the values of the consumption-generation imbalance of the UES of Kazakhstan as a whole and with a breakdown by zones on an annual basis.
6.3. Assessment of the possible value of the installed capacity and energy intensity of the energy storage systems, as well as their possible locations, taking into account the plans for the connection of new RES capacities.
6.4. An overview of available technologies for energy storage systems that have reached market maturity, their technical and technological features, and aggregated price indicators.

7. Conclusions and recommendations of the study.

8. The conclusions drawn, and formulated recommendations should be submitted and presented for joint discussion to the Ministry of Energy of the Republic of Kazakhstan with the participation of interested parties, including the network operator, regional power grid companies, associations (RES/electricity, etc.). Based on the results of joint discussions, the necessary adjustments to the conclusions and recommendations, or any other necessary follow-up work (e.g., review and verification of research work) have to be done accordingly.

The Contractor must use in the study the previously completed work within the framework of the UNDP / GEF Project "Reducing the Risks of Investing in Renewable Energy Sources in Kazakhstan": "Feasibility studies on connecting low-capacity renewable energy sources to power grids in the Turkestan region" RES in Kazakhstan ".

Expected results:

The deadlines for task completion are as shown in the following table:

No.	Results	Deadline	Checked and approved
1.	Works performed in accordance with Tasks 1, 2 and 3 The analysis of the reporting indicators of the power system of the Republic of Kazakhstan has been carried out.	12 weeks upon contract signing	ICTA (preliminary check) and project manager
2.	Works performed in accordance with Tasks 4 and 5 a study of the technological feasibility of power grid construction within the framework of the integration of the power system of the Western energy zone with the UES of Kazakhstan, carried out, including justifications for electrical calculations	16 weeks upon contract signing	ICTA (preliminary check) and project manager
3.	Works performed in accordance with Task 6 a study on the prospects for the use of energy storage systems in the Republic of Kazakhstan was carried out	20 weeks upon contract signing	ICTA (preliminary check) and project manager
4.	Works performed in accordance with Tasks 7 and 8 prepared: an analytical report on the study with conclusions and recommendations, and presentation materials for joint discussion with stakeholders, and conducting a joint	24 weeks upon contract signing	ICTA (preliminary check) and project manager

	discussion of the results of the work performed.		

Indispensable conditions:

During the implementation of the assignment, the contractor must ensure that the required outputs (reports, finished goods, excluding the creation of counterfeit goods) are produced safely and legally.

It is necessary to ensure compliance with the legislation and regulatory legal acts of the Republic of Kazakhstan on copyright (and related rights).

All rights to manufactured products, including original documents and their copies, can be transferred to any third party by the client's decision (DREI project), and such transfer can be carried out directly to a third party and immediately after completion and acceptance all works in accordance with this Terms of Reference.

The UNDP project reserves the right to amend the Terms of Reference (up to 20% of the content) but does not allow changes in the general essence of the assignment for consulting services and the cost of services under the Agreement.

In connection with the COVID 19 pandemic, the Contractor undertakes to provide all the necessary protective equipment for its employees and comply with all WHO standards and recommendations for performing work during the epidemic. The service provider is responsible for the proper and timely provision of its employees involved in this Terms of Reference with all necessary personal protective equipment in accordance with the current WHO recommendations (masks, gloves, sanitizers, passing the COVID-19 test (if necessary)), for the entire term of the contract.

Responsibility and accountability:

The contractor is solely responsible for the accuracy and legality of the information provided and for the timely provision of reports.

- Coordinates planned activities with DREI Project Manager and International Chief Technical Advisor (ICTA).
- Collaborates with a team of experts from the DREI project.
- Ensures unconditional fulfillment of the requirements specified in the contract and terms of reference.

Reports and materials: Must be written in Russian in electronic form using MS WORD (2003 and above) in accordance with the UNDP format; Font: Times New Roman, 12.

Duration of work: 6 months after signing the contract (approximately Oct 2021-Mar 2022)

Duty station: The Republic of Kazakhstan. Business trips are not provided.

Required skills, work experience (supplier requirements):

The contractor can be a company/organization, or a consortium, including organizations registered in Kazakhstan and abroad, having the following combined experience and meeting the following requirements:

- Experience of at least 7 years in the preparation (development) of design solutions/documentation for the design of engineering (electric power) systems and networks;
- Work experience of at least 7 years in the preparation (development) of feasibility studies, or business plans in the field of power grid planning, including renewable energy facilities, construction;
- Work experience of at least 5 years in the development of forecast balances of electricity and capacity of utility companies and regional power grids/networks, as well as feasibility studies for power system design, controls, engineering, operations, and maintenance.
- Work experience (relevant to the 3 areas mentioned above) in power systems of more than one country would be an advantage;
- Availability of a Kazakhstani license for the design of engineering systems and electrical networks of at least category 3;
- Availability (in case of a consortium – at least for one of the consortium members) of material and technical, methodological, regulatory, including special software, similar to that used by the System Operator in Kazakhstan, which makes it possible to simulate AC / DC converters for renewable energy sources, as well as the presence of at least 3 employees who have been trained in this software to carry out design work;
- A list of similar services performed showing the client, the name/type of the services/works, the year of the provision of services and the cost (if possible), customer contact details;
- Work schedule (must include the composition of the team and the distribution of responsibilities, descriptions of methods and procedures for performing work);
- At least 5 reviews and recommendations from previous customers for similar/similar services provided;
- Availability of experts with the necessary qualifications and work experience as indicated below (need to attach a detailed CV and documents confirming the qualifications of the experts - diplomas, certificates, etc.);

The staff should consist of the following specialists (with the provision of a detailed resume, diplomas, and other documents confirming experience and qualifications).

Chief Project Engineer:

- Higher education in engineering (electrical, power) with specialization in the field of design of electrical networks and infrastructures;
- At least 10 years of experience in the design of electrical networks/power plants/power grid facilities;
- Experience in the preparation of feasibility studies or business plans in the field of construction of power grid facilities, including renewable energy sources;
- Excellent knowledge of legislative and other regulatory documents in the field of design, development of grid connection studies;
- Excellent presentation and reporting skills;
- Availability of a certificate of professional attestation, if applicable;
- Experience in the preparation of analytical studies and methodological developments in the field of RES and the development of standards, methods, regulatory and technical documents in the field of RES.

Expert 1 - Chief Designer for Engineering Networks and Infrastructures:

- Higher education in engineering (electrical, power) with specialization in the field of power grid/electric power network design;
- At least 7 years of experience in design organizations in engineering and technical positions;
- Experience in the preparation of feasibility studies or business plans in the field of designing power grid facilities, including renewable energy facilities;

- Practical experience in the implementation of power grid projects (construction/design of power transmission lines, substations, and other electrical infrastructure facilities),
- Knowledge of methodological and regulatory documents for the design, construction, and operation of facilities; technical, economic, environmental, and social requirements for the designed facilities;
- Availability of a certificate of professional attestation, if applicable;

Expert 2 - Leading engineer for engineering networks and structures:
- Higher technical or engineering education,
- At least 7 years of experience in design organizations in engineering and technical positions;
- Experience in performing design work and drawing up estimates and financial/technical and economic calculations, including for renewable energy facilities, the performance of the scope of work on the electrical systems;
- Practical experience in determining the cost of repair, installation, and construction work for power grid projects;
- Excellent knowledge of design documentation;

Expert 3 - Leading specialist/economist:
- Higher education in economics,
- At least 7 years of experience in construction and design organizations in the specialty,
- Practical experience in economic calculations/evaluations of feasibility studies or business plans in the field of designing power grid facilities, including renewable energy facilities,
- Knowledge of methodological, regulatory, and other guiding documentation regarding the development of construction, the implementation of design and construction work,

Quotation volume and payment schedule:

%	Deliverable
20	Result 1
35	Result 2
35	Result 3
10	Result 4

Criteria for selecting the best offer

The qualification and methodology assessment will be a maximum of 70%, the maximum quotation rating is 30%.

Terms of reference approved by:

Syrym Nurgaliyev
Syrym Nurgaliev
Project manager
Date: 08-Sep-2021

Assel Nurbekova
Assel Nurbekova
a.i GEF Portfolio Manager
Date: 08-Sep-2021