



Technical Assistance Report

Project Number: 50318-001
Capacity Development Technical Assistance (CDTA)
March 2017

Republic of Kazakhstan: Fostering the Development of Renewable Energy

(Financed by the Clean Energy Fund under the Clean Energy
Financing Partnership Facility)

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Asian Development Bank

CURRENCY EQUIVALENTS

(as of 15 February 2017)

Currency unit	–	tenge (T)
T1.00	=	\$0.0031104
\$1.00	=	T321.5

ABBREVIATIONS

ADB	–	Asian Development Bank
GHG	–	greenhouse gas
KEGOC	–	Kazakhstan Electricity Grid Operating Company
km	–	kilometer
PMU	–	project management unit
TA	–	technical assistance

NOTE

In this report, "\$" refers to US dollars.

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CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data		Project Number: 50318-001	
Project Name	Fostering the Development of Renewable Energy	Department /Division	CWRD/CWEN
Country	Kazakhstan	Executing Agency	Kazakhstan Electricity Grid Operating Company (KEGOC)
2. Sector	Subsector(s)	Financing (\$ million)	
✓ Energy	Electricity transmission and distribution		0.40
	Renewable energy generation - solar		0.30
	Renewable energy generation - wind		0.30
	Total		1.00
3. Strategic Agenda	Subcomponents	Climate Change Information	
Inclusive economic growth (IEG) Environmentally sustainable growth (ESG)	Pillar 1: Economic opportunities, including jobs, created and expanded Natural resources conservation	Climate Change impact on the Project	Low
4. Drivers of Change	Components	Gender Equity and Mainstreaming	
Governance and capacity development (GCD) Knowledge solutions (KNS) Partnerships (PAR) Private sector development (PSD)	Institutional development Application and use of new knowledge solutions in key operational areas Foundations Official cofinancing Public sector goods and services essential for private sector development	No gender elements (NGE)	✓
5. Poverty and SDG Targeting		Location Impact	
Geographic Targeting Household Targeting SDG Targeting SDG Goals	No No Yes SDG7, SDG13	Not Applicable	
6. TA Category:	B		
7. Safeguard Categorization	Not Applicable		
8. Financing			
Modality and Sources		Amount (\$ million)	
ADB		0.00	
None		0.00	
Cofinancing		1.00	
Clean Energy Fund under the Clean Energy Financing Partnership Facility		1.00	
Counterpart		0.40	
Beneficiaries		0.40	
Total		1.40	
9. Effective Development Cooperation			
Use of country procurement systems		No	
Use of country public financial management systems		No	

I. INTRODUCTION

1. On 30 May 2013, the President of Kazakhstan approved the Concept for Transition of the Republic of Kazakhstan to Green Economy, which set targets for power generation from renewable energy sources (wind and solar) of 3% by 2020 and 10% by 2030¹. Separately, Kazakhstan's Intended Nationally Determined Contribution under the 2015 Paris Agreement set a target to unconditionally reduce greenhouse gas (GHG) emissions by 15% (25% conditional) by 2030 compared to the 1990 baseline. The targets are ambitious and require thorough planning to make them achievable.

2. In August 2016, the Ministry of Energy requested the Asian Development Bank (ADB) to provide technical assistance (TA) for the Kazakhstan Electricity Grid Operating Company (KEGOC) to strengthen its capacity in power system planning for the integration of renewable energy sources into the national grid.² The TA supports the development of clean energy and the reduction of GHG emissions, which are included as a core development area in the country partnership strategy, 2012–2016 for Kazakhstan.³

3. The TA concept was formulated with the Ministry of Energy, state-owned power generation company Samruk-Energy, and KEGOC;⁴ and is expected to benefit their respective operations.⁵ The design and monitoring framework is in Appendix 1.

II. ISSUES

4. The Government of Kazakhstan is committed to increase the share of electricity generated from renewable energy sources in the overall power generation portfolio and reduce GHG emissions. In addition to the decree mentioned above, the government in 2013 approved a road map and a plan for renewable energy generation plants until 2020. In 2014, the government approved feed-in tariffs for electricity generated from wind and solar generation sources. In 2015, the Ministry of Energy designated the Financial Settlement Centre for Support to Renewable Energy Sources LLP as a buyer and seller of electricity generated from large-scale renewable energy sources. The Financial Settlement Center is a subsidiary of KEGOC. KEGOC has technical and commercial interest in integrating into the grid, and transmitting and selling the electricity generated from renewable sources. In 2016, the Ministry of Energy decided to start auctioning renewable energy projects for which a related mechanism is currently being developed.⁶

5. Despite established legal and commercial frameworks, the penetration of renewable energy generation remains low. As of January 2016, the total installed power generation capacity of Kazakhstan was 21,307 megawatts, of which 87.0% was based on fossil fuels. Another 12.0% of generation was from hydropower plants, while the generation from wind and solar accounted only for 0.6% of total installed capacity.⁷

6. KEGOC has been successfully managing Kazakhstan's high-voltage grid (approximately

¹ Government of Kazakhstan. 2013. *Decree No. 577: Decree of the President of the Republic of Kazakhstan dated 30 May 2013—Concept of transition of the Republic of Kazakhstan to “green economy.”* Astana http://www.pavlodar.gov.kz/page.php?page_id=66&lang=3.

² KEGOC is a state-owned electricity transmission and dispatch joint-stock company.

³ ADB. 2012. *Country Partnership Strategy: Kazakhstan, 2012–2016*. Manila.

⁴ The consultation missions were fielded in December 2015 and May 2016 and fact-finding mission in August 2016.

⁵ The TA first appeared in the business opportunities section of ADB's website on 26 October 2016.

⁶ The development of this mechanism is being supported by ADB.

⁷ Source: KEGOC.

25,000 kilometers) since Soviet times. Its staff has vast experience in operation, planning, and maintenance of the network supplied from conventional energy generation sources (coal, gas, and hydropower). Russian system planning software RastWin and Mustang, used by KEGOC, were sufficient to undertake static and dynamic stability analysis of integration of conventional generation sources.

7. The 3% target of renewable energy share for 2020 (para. 1) does not look high, however, if the concentration of renewable energy generation sources in one region is high and the grid is weak, the impact on the power system in that region will be substantial. Presently, KEGOC does not possess sufficient technical capacity and tools to analyze the impact of integrating intermittent energy, such as solar and wind, to the grid. Consequently, the applications from public and private sector developers on the construction of new wind and solar power plants are deferred until their impact on the power system is analyzed and adequate grid reinforcement measures are undertaken.

8. KEGOC, responding to the increasing pressure from the government, started to analyze financial, legal, technical operations, and system planning aspects of increased renewable energy penetration that could impact its operations. The International Finance Corporation supported KEGOC in this process. They organized workshops, including those related to system planning, where various modern tools were discussed. After studying several alternatives in detail, KEGOC's technical team and management selected system planning software PowerFactory produced by the German company DlgSILENT as the most appropriate to meet the objectives. PowerFactory was selected for its (i) complete user interface, all-analytic functions, and customized add-ons in Russian language; (ii) full Russian language support; and (iii) former Soviet Union-type equipment database.⁸

9. The Ministry of Energy and KEGOC have limited experience with renewable energy projects, particularly on the technical side. Therefore, the government decided to implement the project with the help of development partners and requested ADB support with procurement and installation of the modern system planning software PowerFactory. This tool is required not only to meet the 2020 renewable energy target, but to undertake long-term planning to meet 2030 and 2050 renewable energy generation targets.

III. THE CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE

A. Impact and Outcome

10. The impact will be electricity supply from renewable energy sources in Kazakhstan increased to 3% by 2020. The outcome will be transmission system operator's capacity for planning and modeling of the integration of variable power generation sources into the Kazakh power system established.

B. Methodology and Key Activities

11. The TA outputs are the following:

⁸ In 2008, the United States Agency for International Development funded the Regional Energy Markets Assistance Program, which procured similar system planning software PSS@E for system operators in Kazakhstan, Kyrgyz Republic, Tajikistan, and Turkmenistan; and for the Coordination and Dispatch Center in Tashkent, Uzbekistan. However, none of these entities ever used this software due to absence of a Russian language interface.

- (i) KEGOC's transmission system planning and operation staff trained on modern system planning tools;
- (ii) KEGOC's system planning tools improved; and
- (iii) a list of transmission grid reinforcement projects necessary to integrate electricity generated from renewable energy sources prepared.

12. Together, these outputs and associated activities will contribute to the efficiency improvements in the operation and planning of the power system. KEGOC's planning and system operation staff will be equipped with the skills, knowledge, and tools to analyze the impact of renewable energy integration to the grid. This will expedite the increase of renewable energy project development and will achieve the country's 3% target of renewable energy share by 2020. The proposed TA is also expected to lead to further investments in transmission and renewable energy projects.

13. A possible risk for the TA is the limited number of highly skilled technical consultants who are capable to conduct the system studies specified (i.e., the studies to analyze the impact of renewable energy integration to a country's grid utilizing simulation software). To mitigate this risk, advertisements will be taken out across various media outlets to garner interest from qualified consultants.

C. Cost and Financing

14. The TA is estimated to cost \$1,400,000, of which \$1,000,000 will be financed on a grant basis by the Clean Energy Fund⁹ under the Clean Energy Financing Partnership Facility and administered by ADB. The remaining \$400,000 will be financed by KEGOC. The cost estimates and financing plan are in Appendix 2.

15. KEGOC will provide counterpart support in the form of equipment and backup systems for the installation of new planning software, taxes, counterpart staff, office space and furniture, internet, telecommunication, and other in-kind contributions.

D. Implementation Arrangements

16. The TA will be implemented from March 2017 to February 2018. The executing agency for the TA will be KEGOC, which will be monitored by the Ministry of Energy. The Energy Division of ADB's Central and West and Asia Department will closely monitor the implementation of the TA.

17. ADB will recruit a firm of international consultants to undertake this task, using the quality- and cost-based selection (QCBS) method using simplified technical proposal, following ADB's Guidelines on the Use of Consultants (2013, as amended from time to time). Quality-cost weighting of 90:10 will be used to maximize the quality of the complex system analysis. The TA requires international consultant inputs of 21 person-months. The required areas of expertise include (i) transmission planning and (ii) material and costing engineering. The outline terms of reference are in Appendix 3.

18. The expected results are in line with the TA's outputs. Of the total TA cost, \$410,000 will be allocated as provisional sums for the procurement of the transmission system planning software and associated licenses. The software will be procured in accordance with ADB's

⁹ Financing partners: the governments of Australia, Norway, Spain, Sweden, and the United Kingdom.

Procurement Guidelines (2015, as amended from time to time) under the direct contracting (single source) method (para. 8).

19. Trained KEGOC employees are expected to disseminate the knowledge and skills they have obtained from the TA to the other KEGOC staff. In this manner, the outcome will be spread over the KEGOC, specifically planning and system operation staff, strengthening the institutional capacity on renewable energy integration.

IV. THE PRESIDENT'S DECISION

20. The President, acting under the authority delegated by the Board, has approved ADB administering technical assistance not exceeding the equivalent of \$1,000,000 to the Government of Kazakhstan to be financed on a grant basis by the Clean Energy Fund under the Clean Energy Financing Partnership Facility for Fostering the Development of Renewable Energy, and hereby reports this action to the Board.

DESIGN AND MONITORING FRAMEWORK

Impact the TA is Aligned with			
Electricity supply from renewable energy sources in Kazakhstan increased to 3% by 2020. ^a			
Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
Outcome Transmission system operator's capacity for planning and modeling of the integration of variable power generation sources into the Kazakh power system established.	a. Modern transmission planning system operational by 2018	a. KEGOC annual management report	Unfavorable macroeconomic conditions deter investments in renewable energy
Outputs 1. KEGOC's transmission system planning and operation staff trained on modern system planning tools 2. KEGOC's system planning tools improved 3. A list of transmission grid reinforcement projects necessary to integrate electricity generated from renewable energy sources prepared	1a. At least two workshops to train 24 transmission system planning and operations staff, of which 30% are female, completed by 2017 (2016 baseline: NA) 2a. Power system modeling, analysis, and simulation software installed at KEGOC by 2017 (2016 baseline: NA) 2b. Kazakh transmission grid converted or built into a new platform by 2017 (2016 baseline: NA) 3a. Power system simulations and analysis completed by 2018 (2016 baseline: NA)	1a. KEGOC annual management report and TA final report 2a. KEGOC annual management report and TA final report 2b. KEGOC annual management report and TA final report 3a. KEGOC annual management report and TA final report	Limited number of highly skilled technical consultants participating
Key Activities with Milestones 1. KEGOC's transmission system planning and operation staff trained on modern system planning tools 1.1 Training needs assessment completed by March 2017 1.2 Two training workshops on modern transmission system planning tools for integration of renewable energy generation sources completed by June 2017			

2. KEGOC's system planning tools improved

- 2.1 All licenses for a new planning software procured by March 2017
- 2.2 All hardware and backup systems procured by March 2017
- 2.3 All hardware and software installed by April 2017
- 2.4 Kazakh power system converted into a platform by August 2017

3. A list of transmission grid reinforcement projects necessary to integrate electricity generated from renewable energy sources prepared

- 3.1 Simulations and power system analysis commenced by September 2017

Inputs

Clean Energy Fund under the Clean Energy Financing Partnership Facility: \$1,000,000

KEGOC: \$400,000

Note: KEGOC will provide counterpart support in the form of equipment and backup systems for the installation of new planning software, taxes, counterpart staff, office space and furniture, internet, telecommunication, and other in-kind contributions.

Assumptions for Partner Financing

Not Applicable

KEGOC = Kazakhstan Electricity Grid Operating Company, NA = not applicable, TA = technical assistance.

^a Government of Kazakhstan. 2013. *Decree No. 577: Decree of the President of the Republic of Kazakhstan dated 30 May 2013—Concept of transition of the Republic of Kazakhstan to “green economy.”* Astana. http://www.pavlodar.gov.kz/page.php?page_id=66&lang=3.

Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
(\$'000)

Item	Amount
Clean Energy Fund^a under the Clean Energy Financing Partnership Facility	
1. Consultants	
a. Remuneration and per diem	
i. International consultants	500.0
b. International and local travel	40.0
c. Reports and communications	3.0
2. Workshops, training, seminars, and tripartite meetings	4.0
3. Vehicle rental	10.0
4. Miscellaneous administration and support costs	10.0
5. Provisional sum (software and associated licenses) ^b	410.0
6. Contingencies	23.0
Total	1,000.0

Note: The technical assistance (TA) is estimated to cost \$1,400,000, of which contributions from the Clean Energy Fund under the Clean Energy Financing Partnership Facility are presented in the table above. The government will provide counterpart support in the form of equipment and backup systems for the installation of new planning software, taxes, counterpart staff, office and furniture, internet, telecommunication, and other in-kind contributions. The value of government contribution is estimated to account for 28.6% of the total TA cost.

^a Financing partners: the governments of Australia, Norway, Spain, Sweden, and the United Kingdom. Administered by the Asian Development Bank.

^b The software and associated licenses will be procured under the executing agency's name.

Source: Asian Development Bank estimates.

OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

A. Summary

1. The Asian Development Bank (ADB) will recruit a firm of consultants to strengthen the capacity of the country's transmission system operator, Kazakhstan Electric Grid Operating Company (KEGOC). ADB and KEGOC will work together in planning and modeling the integration of variable power generation sources into the national grid in Kazakhstan, and in performing long-term transmission planning studies on the integration. Part of the work will be utilized for a future ADB financing opportunity. KEGOC will be the executing agency for the technical assistance (TA) and a project management unit (PMU) will perform overall project coordination. KEGOC will allocate sufficient resources and qualified personnel to the PMU to accomplish the task. The PMU will work closely with the consultants.

2. The assignment requires a total of 21 person-months of input. The consultants will be recruited in line with ADB's Guidelines on the Use of Consultants (2013, as amended from time to time).

B. Background

3. The Government of Kazakhstan intends to achieve 3% of its generation from renewable sources by 2020 and 10% by 2030. The government carried out preliminary studies to determine the renewable resources and identified three regions for construction of renewable energy generation. However, the reinforcements required to help integrate power generated from renewable resources into the existing grid are yet to be determined. The specific grid reinforcements that are required to maintain grid code-compliant operation from both a steady-state and dynamic response point of view should be determined through electrical studies. Thus, the KEGOC intends to employ a reputable consultant to identify the necessary steps to be taken in Kazakhstan for the economical and reliable integration of renewable energy projects into the grid.

4. The software platform currently used by KEGOC does not have the capability to model variable generation. Thus, the system data should be migrated to an industry-standard planning software tool. KEGOC's technical team and management made the decision to procure the simulation software PowerFactory from the German company DlgSILENT. The consultants will help KEGOC migrate the data to the selected software platform.

C. Scope of Work

5. The following items are the main tasks:
- (i) The consultants will provide training on electricity regimes during transmission planning for KEGOC staff (for groups up to 10–12 people for 2 weeks each) using system model.
 - (ii) The consultants will convert existing system models—(a) building the Kazakhstan network model using the new software based on manufacturers' information of the hardware and data imported from the existing software and data transmission systems (e.g., supervisory control and data acquisition), and (b) updating the model to represent the planning horizon—to prepare the 1,150-kilovolt transit model for a tree-phase design.

- (iii) The consultants will convert the existing system models (currently in the software platform) into a new format and verify and complement the data based on the manufacturers' information for the hardware. The following models are required to be converted: (a) models for estimating the steady states (static models), and (b) models for estimating electro-mechanic transition processes—(dynamic models).
- (iv) The consultants will test converted models to check that they represent existing system characteristics and conditions. These models are to be adapted to enable the simulation of future studies in 2020, 2025, and 2030, considering projected load growth and planned system expansions.
- (v) The consultants will provide additional services and take into account the specifics of Kazakhstan's system operation to improve the performance of the new planning software.
- (vi) The consultants will include the renewable energy sources in the system model. They will add the existing and planned renewable energy sources and related component models (e.g., control functions and reactive power compensation devices) to both static and dynamic models of the system.
- (vii) The consultants will perform transmission planning studies to identify network facilities required to operate the transmission system when planned wind and solar generation is added during 2020–2030 and possibly beyond. The studies should include different credible operating scenarios that consider various levels of renewable energy penetration. The consultants will perform the following analyses to identify system limitations in transferring power generated by wind and solar generators to the load centers:
 - (a) steady state analysis of regimes;
 - (b) short circuit analysis;
 - (c) verification of the permitted flows for basic sections following the conditions of preserving dynamic stability under the reference incidents,
 - (d) impact of renewables on load schedule; and
 - (e) analysis and assessment of technical requirements to integrate renewables into the energy system of Kazakhstan, with the aim of preserving the maximum permitted flows through the main controllable sections.
- (viii) The consultants will carry out the following analyses to identify the development scenarios for electric grids in Kazakhstan:
 - (a) identification of bottlenecks, given the development of renewables, and planning actions to create reserves and manage response capacity to prevent risk of instability of the Kazakhstan energy system using power-voltage and reactive power-voltage curves, sensitivity, and modal analysis;
 - (b) analysis and assessment of the existing 220-kilovolt and above network of the Kazakhstan energy system given the existing projects for national network development;
 - (c) proposals for the national energy system development to 2030; the development scenarios of the national energy system should be considered based on the scenarios of forecasted balances of power and capacity of the Kazakhstan energy system;
 - (d) development proposals for the national energy system should take into account advanced and innovative technologies;
 - (e) national energy system development proposals should be provided with the breakdown by system zones of Kazakhstan;

- (f) all studies should be carried out for the four worst operational conditions given the load and generation (conventional and renewable energy sources); the four worst operational scenarios (for example, winter with high/low generation or summer with low/high generation) should be defined by KEGOC; and
- (g) the recommended identification of zones of Kazakhstan is as follows: North Zone (Akmola, Pavlodar, Kostanai, North Kazakhstan, East Kazakhstan, Karaganda, Aktobe regions); South Zone (Almaty, Zhambyl, South Kazakhstan, Kyzylorda regions); and West Zone (Atyrau, Mangistau, and West Kazakhstan regions).

D. Outputs and Implementation Arrangements

- 6. The consultants are expected to spend at least 70% of their time in Kazakhstan working with KEGOC. The consultants will maintain records documenting decisions made at meetings, progress on works, certified achievements and milestones, financial records, and any deviations from or changes to the contract plans.
- 7. KEGOC and the PMU will be the counterparts from the Kazakh side. The PMU and KEGOC will provide all necessary assistance to the TA consultants in liaising with other government ministries and agencies, and will also assist in data gathering, preliminary analysis, and report writing.
- 8. All reports will be in the English and Russian languages. All documents and reports will be made available in an electronic format acceptable to ADB.

E. Required Experts and Level of Effort

9. A total of 21 international person-months of consulting services will be required. The international consultant team composition, along with their estimated input, is provided in Table A3.

Table A3: International Consulting Services Requirement

Positions	Number of experts	Person-months per expert	Total person-months
1. Transmission Planning Expert (Team Leader)	1	7	7
2. Transmission Planning Analyst	3	4	12
3. Material and Costing Engineering Expert	1	2	2
Total	5		21

Source: Asian Development Bank and Kazakhstan Electric Grid Operating Company estimates.

10. **International experts.** Proficiency in the English language is essential, while ability in the Russian language is advantageous. Previous work experience in Kazakhstan and other former Soviet Union countries, as well as work experience with ADB (or any other international financial institutions such as the World Bank, European Bank for Reconstruction and Development, and the United States Agency for International Development) and ADB-financed projects, is desirable. The consulting team shall assist the team leader in maintaining the quality of the overall outputs and completing deliverables in a timely manner.

11. **Transmission planning expert (team leader).** The expert shall have a doctorate degree or master's degree in electrical engineering. In addition, the expert shall have at least 15 years of experience in transmission expansion planning. The expert shall oversee transmission planning analysts in performing the following tasks:

- (i) conducting training on transmission planning studies;
- (ii) converting existing system models and updating the models to represent the planning horizon;
- (iii) including the renewable energy sources in the system model; and
- (iv) performing transmission planning studies and analyzing different scenarios.

12. **Transmission planning analysts (three positions).** The analysts shall have at least a bachelor's degree in electrical engineering. The analysts shall have at least 10 years of experience in transmission expansion planning software tools and the certificates of the completed software courses. They will assist in performing the following tasks:

- (i) conducting training on transmission planning studies;
- (ii) converting existing system models and updating the models to represent the planning horizon;
- (iii) including the renewable energy sources in the system model; and
- (iv) performing transmission planning studies and analyzing different scenarios.

13. **Material and costing engineering expert.** The expert shall have at least a bachelor's degree in electrical engineering and a minimum of 15 years of experience in the electric power industry. The expert shall have expertise in equipment international standards and equipment manufacturing processes; and overall project knowledge related to purchase, manufacture, shipping, construction, commissioning, and operations and maintenance. The expert shall have a demonstrated working knowledge and expertise in preparing realistic cost estimates. The expert shall demonstrate working knowledge and expertise in assigning contingency funds based on the amount of detailed information available about the project, risk, and other sensitivities.