M.S. Dissertation in Engineering

Competitiveness of Kazakhstan's Renewable Energy Industry and its Implications for Central Asian Cooperation

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ABSTRACT

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Kazakhstan has enormous renewable energy potential, particularly from wind, solar and small hydropower plants. But renewable energy share accounts for less than one percent of all power installations. It is important for Kazakhstan to develop renewable energy sector as the energy demand is growing and the green energy is one of the ways of meeting the energy need of the country.

Through the Michael Porter's model "Determinants of National Competitive

Advantage" this research examines competitiveness of renewable energy industry of Kazakhstan. Moreover, basics from other Central Asian countries renewable energy frameworks and industries were considered in order to extract recommendations and identify appropriate strategies for promotion of renewable energy in Kazakhstan. The SWOT analysis was applied to examine strengths, weaknesses, opportunities, and threats of Central Asian cooperation in renewable energy field in the context of advancing renewable energy policies and technologies and expanding domestic renewable energy installations through this cooperation. Based on SWOT analysis, the strategies were developed using the TOWS Matrix.

The analysis of Michael Porter's factors indicated the possibility of creating in Kazakhstan the world class Renewable Energy industry. However, challenges lie in the path of that prosperity continuing. Kazakhstan's future performance is constrained by a dependence on natural resources, a weak manufacturing sector and lack of specialists. Some policy implications were suggested, such as:1) the establishment of a policy, facilitating competition between renewable energy and fossil fuels; 2) increase of private and public sector financial support for the commercialization and deployment of Kazakhstan renewable energy; 3) enhancing the ability of the

Kazakhstan manufacturing sector to support the renewable energy industry; 4) training of specialists.

SWOT-analysis of cooperation between Kazakhstan and other Central Asian countries demonstrated the significant advantages of such cooperation for renewable energy development. Through the SWOT analysis, this study identifies a capacity for additional renewable energy deployment and development in Kazakhstan and highlights the necessity of increased cooperation between Kazakhstan and other Central Asian countries in order to strengthen and improve domestic and regional renewable energy sectors.

Keywords: Renewable Energy, SWOT analysis, Kazakhstan, Central Asian Cooperation

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Chapter 1 Introduction

1.1 Overview

Today, renewable energy sources are the most dynamic forms of energy generation in the world. The use of renewable energy as an alternative to traditional energy sources at the present stage is a strategic objective in the national and regional scales. The undeniable advantage of their application are inexhaustible and environmental cleanliness, as well as the need to ensure energy security by diversifying the use of energy resources, reduce harmful emissions, save energy resources for future generations, as well as in security of energy supply in remote areas. This global trend is apparent in Central Asian countries as well, where countries such as Kazakhstan have enacted specific regulatory framework aimed to promote the use of renewable energy.

In accordance with the message of the President of Kazakhstan in Strategy 2030 of the long-term Priorities 5: ENERGY RESOURCES

> Kazakhstan has vast natural resources, especially energy. In our country there are deposits of oil and gas, which put us in the top ten oil-producing countries. Kazakhstan also has large reserves of coal, uranium, gold and

other valuable minerals. We have a great potential for the use of solar and wind energy. Despite this, we cannot provide our domestic needs for the past several years. This is a consequence of the distribution system, which was established during the Soviet period, as well as our lack of the necessary infrastructure (October, 1997).

Moreover, reserves of non-renewable natural resources in Kazakhstan may be exhausted within a limited historical period. According to experts, today's oil reserves in Kazakhstan with intensive use will last for 70 years, natural gas - for 85 years.

All Central Asian countries are endowed with energy resources and the countries have considerable potential for development of renewable energy. However, renewable energy sources account for only a small proportion of total energy consumption.

This paper analyzes the development of renewable energy in Kazakhstan and discusses the prospects of international cooperation in this field.

1.2 Research Background

Today, the topic of renewable energy sources is relevant for Kazakhstan. Throughout the country's energy industry there is high deterioration of equipment: up to 70% in the sector of electricity generation and 57% in electric networks. The

population in remote areas of the country in varying degrees has problems with access to energy. Increasing economic activity entails the growth in electricity consumption, and in some regions of Kazakhstan there are still energy deficit. Moreover, a key factor in the use of renewable energy in Kazakhstan, as in many regions of the world, is the need to reduce the negative impact of energy on the environment.

1.2.1 Climate change vulnerability

The climate of Kazakhstan became considerably warmer between 1936 and 2005. Each 10 years, the average annual temperature in the country increased at an average 0.310C. Most parts of the country have seen a doubling of the frequency of heat-waves, and a decrease in the duration of cold waves.

The concern over climate change in Kazakhstan and Central Asia, in general, is particularly linked to water availability and energy security which directly affect the lives of the people in the region. For instance, as a result of global warming, glaciers in the region are melting at a significant rate and quantities and qualities of water resources are at risk.

1.2.2 Carbon and energy intensity in Kazakhstan

Kazakhstan, being rich in energy resources, has an energy intensive economy and large emissions of CO2, as well as in per capita and terms. Kazakhstan is still one of the world's biggest carbon emitters among countries with such economy. According to Germanwatch's latest Climate Change Performance Index, Kazakhstan was one of the worst-performing countries.[1]

In 2009 the carbon intensity of Kazakhstan stood at 1.42 the second highest after Uzbekistan - 1.69among transition countries. For comparison, at the same time, the Russian Federation had a carbon intensity of 1.00, China - 0.56, the United States - 0.46, India - 0.35 [OECD, 2012].

In 2009, according to the data of the Ministry of Environmental Protection, the emissions of pollutants were 3.4 million tons, of which 85% comes from 43 large enterprises. Currently in Kazakhstan the 85% of the total electricity is produced by combustion of fossil fuel, mainly local coal, to a lesser extent - hydrocarbons.

The overall reduction of greenhouse gas emissions from energy use of

[1]https://germanwatch.org/en/7704Climate Change Performance Index: Emissions are rising - but there is a glimmer of hope

renewable energy could reach 500 thousand tons to 2.5 million tons of CO2.

1.2.3 CO2 reduction targets

Kazakhstan is party to both the United Nations Framework Convention on Climate Change and the Kyoto Protocol. Kazakhstan signed the Kyoto Protocol in 1999 and ratified it in 2009. It is currently a non-Annex I (under the Convention) and a non-Annex B country (under the Kyoto Protocol).

The Government of Kazakhstan has set for itself very ambitious targets for reducing CO2 emissions. Kazakhstan has pledged to reduce its emissions by 15% by 2020 and 25% by 2050 from a base of 1992.

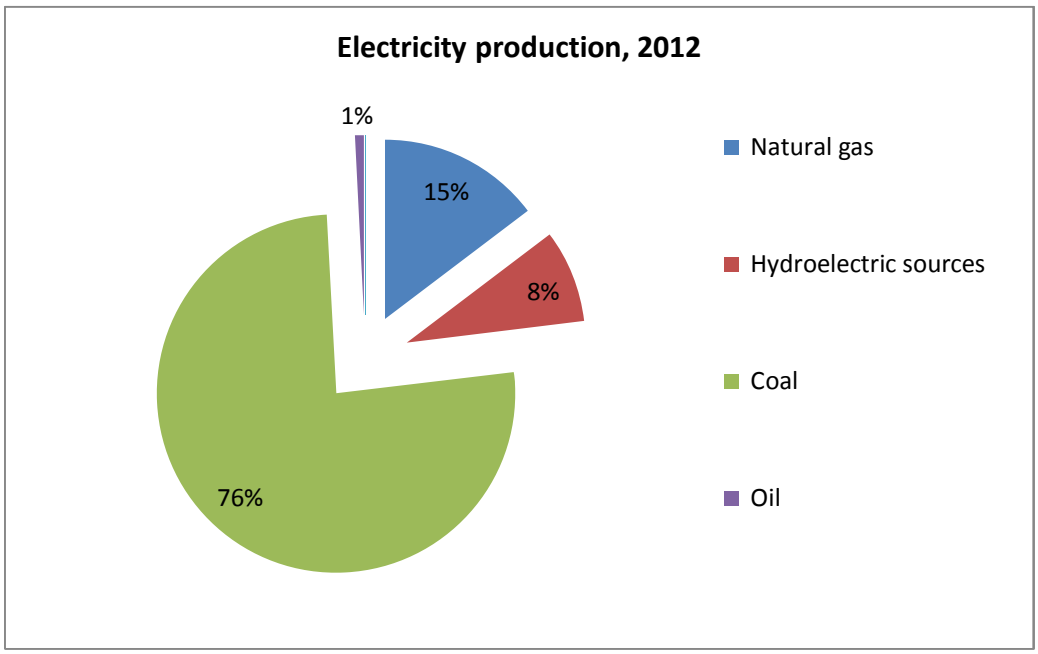
1.2.4 Energy mix in the country

Kazakhstan is rich in fossil fuels – in particular coal – and is a major producer of oil, gas and uranium as well. Fossil fuels dominate not only in the production, but also in consumption of energy in Kazakhstan. In terms of energy balance, there is a steadily rising primary energy surplus largely due to the increase of the crude oil and gas production and surplus of coal production.

Even though Kazakhstan has significant reserves of renewable energy, the share of renewable energy is less than 1%, excluding hydroelectric sources. However

if efforts are made, this share can increase significantly.

[Figure 1-1] Electricity production mix in 2012



Source: World Bank

1.3 Research Questions

With this perspective this thesis will address following research questions:

- What are the main challenges hindering the development of renewable energy in Kazakhstan?

- What is the possible framework in promoting of renewable energy in Kazakhstan?
- How can Central Asian cooperation facilitate the development of renewable energy in Kazakhstan?

1.4 Research Objectives

The primary purpose of this research is to investigate renewable energy policies in Kazakhstan, analyze their advantages and shortcomings for renewable energy development, and provide possible guidance for future expansion of renewable energy in Kazakhstan.

- To identify and analyze the challenges of renewable energy development in Kazakhstan
- To develop framework to promote the renewable energy in Kazakhstan.

1.5 Structure of Thesis

This thesis is composed of 7 chapters. Chapter 2 presents general information about Kazakhstan. Chapter 3 describes the Methodology. Chapter 4 reviews Kazakhstan energy sector in generally and renewable energy sector (potential, regulatory framework, current situation, barriers for development). Chapter 5 shows

the information about renewable energy promotion frameworks in Central Asian countries. Chapter 6 provides an analysis by utilizing Michael Porter's model "Determinants of National Competitive Advantage". Chapter 7 compares the renewable energy industries within Central Asian countries and presents Strength, Weakness, Opportunity, and Threat (SWOT) matrix as an analysis framework and prospects of interstate cooperation on promotion of renewable energy and, lastly, provides recommendations based on TOWS matrix. Chapter 8 provides recommendations in order to expand renewable energy operations in Kazakhstan.

Chapter 2 Country Overview

2.1 General Information

The Republic of Kazakhstan is a unitary state with the presidential form of government. Kazakhstan declared its independence on 16 December 1991. The capital of the country is the Astana city. The state language is Kazakh, and Russian language has the status of the language for interethnic communication. The national currency is the tenge (KZT).

The Republic of Kazakhstan is located in the center of the Eurasian continent and has territory of 2,724,900 km2 it is the ninth largest country among the states in the world and the fourth largest one among the countries in Eurasia. In the west and north, Kazakhstan has border with Russia; in the east - with China; in the south - with Uzbekistan, Kyrgyzstan, and Turkmenistan.

[Figure 2-1] Map of Kazakhstan2

Since the country is located away from any oceans, the climate in Kazakhstan is mainly continental. The average temperature in winter varies from −19oC in the north to −5 °C in the south, in some northern regions the temperature may fall to -58 °C. The average temperature in summer is +19 °C in the north and +28 °C in the south; in some regions the temperature may reach +50 °C.

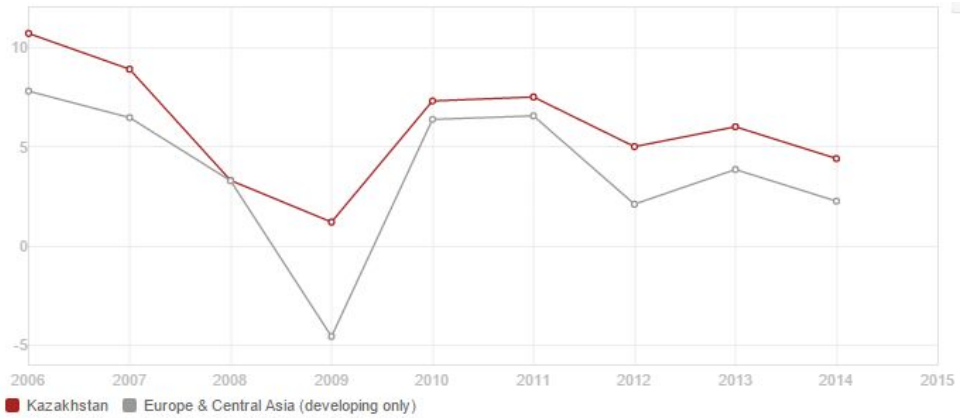
2.2 Economy

Kazakhstan is an upper-middle-income country with GDP per capita of

[2]https://www.cia.gov/library/publications/the-world-factbook/geos/kz.html

nearly US$ 13 thousand in 2013. Its real GDP growth decreased from 6 percent in 2013 to 3.9 percent during the first half of 2014, due to internal capacity limits in the oil industry, less favorable conditions of trade, and an economic slowdown in Russia.

[Figure 2-2] GDP growth annual (%)[3]



Since Kazakhstan gained independence in 1991, it has made significant progress toward creating a market economy and has achieved considerable outcomes in its efforts to attract foreign investments. As of September 30, 2014, total foreign investment in Kazakhstan reached USD 211.5 billion. The majority of foreign investment is in the oil and gas sector.

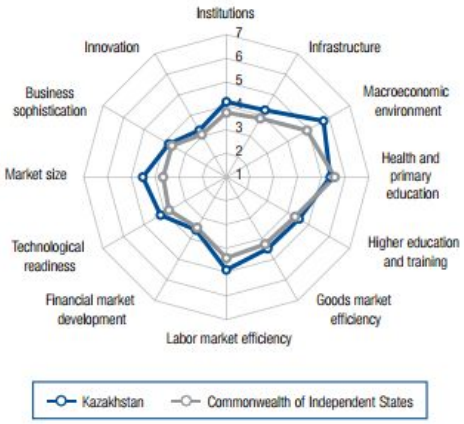
[3] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/countries/kz-7E?display=graph

Kazakhstan ranks No. 41 in the Doing Business 2016 ranking by the World Bank. The country was also No. 34 in the World Competitiveness Ranking by the International institute for Management Development in 2015. Kazakhstan ranks No. 42 among 140 countries worldwide in the Global Competitiveness Index of the World Economic Forum (WEF).

[Figure 2-3] Global Competitiveness Index of the Republic of Kazakhstan4

Global Competitiveness Index

	Rank (out of 140)	Score (1–7)
GCI 2015–2016	**42**	**4.5**
GCI 2014–2015 (out of 144)	50	4.4
GCI 2013–2014 (out of 148)	50	4.4
GCI 2012–2013 (out of 144)	51	4.4
Basic requirements (40.2%)	**46**	**4.9**
1st pillar: Institutions	50	4.2
2nd pillar: Infrastructure	58	4.2
3rd pillar: Macroeconomic environment	25	5.7
4th pillar: Health and primary education	93	5.4
Efficiency enhancers (49.9%)	**45**	**4.4**
5th pillar: Higher education and training	60	4.5
6th pillar: Goods market efficiency	49	4.5
7th pillar: Labor market efficiency	18	4.9
8th pillar: Financial market development	91	3.6
9th pillar: Technological readiness	61	4.2
10th pillar: Market size	46	4.5
Innovation and sophistication factors (10.0%)	**78**	**3.5**
11th pillar: Business sophistication	79	3.8
12th pillar: Innovation	72	3.3



Kazakhstan is an industrial country where production of mineral resources is

[4] http://www3.weforum.org/docs/gcr/2015-2016/KAZ.pdf

one of the key drivers of economic growth. The country's mineral portfolio consists of over 5 thousand fields estimated at dozens of trillions of US dollars. Kazakhstan has the largest proved reserves of zinc, tungsten and barite worldwide; it ranks No. 2 in silver, lead and chromite reserves, No. 3 in copper and fluorite reserves, No. 4 in molybdenum reserves, and No. 6 in gold reserves. With regard to energy resources, according to the BP Statistical Review of World Energy 2014, Kazakhstan ranks No. 12 in proved oil reserves and No. 21 in proved gas reserves worldwide. In addition, the republic is No. 8 in coal reserves and No. 2 in uranium reserves [KazEnergy, 2014].

Development of agricultural sector has historically been on top of the national agenda, in addition to the production sector. The country ranks among the world's top ten grain exporters and is one of the leading flour exporters. Industrial crops and grain such as wheat, barley, and millet occupy up to 70% of farm lands in the north of the country. Kazakhstan produces rice, cotton, and tobacco in the southern part of the country.

Despite considerable natural resources, the country seeks to develop non-energy export-oriented sectors and ultimately switch to the production of high-tech products. In this context, Kazakhstan launched the State Program of Accelerated

Innovation and Industry Development for the Republic of Kazakhstan (SPAIID) in 2010.

However, the efforts made by the country have not changed the structure of the national economy in a dramatic way. Most non-energy sectors are still poorly productive and poorly competitive. The country is still sensitive to fluctuating commodity prices. In this respect, the government is planning to take more aggressive steps to carry out the second five-year industrial plan (SPAIID-2) in 2015-2019.

At present, the country is embarking on a new development strategy called Kazakhstan-2050. The main aim of this strategy is for Kazakhstan to rank among the top 30 developed countries by 2050. The new course of development should create a competitive and science-based model of the national economy.

2.3 Energy Sector

The energy sector is one of the most developed sectors of the economy of Kazakhstan. The Republic of Kazakhstan is rich in fossil fuels, which account for about 4% of the world reserves of fuel.

In 2012 the total volume of primary energy production in Kazakhstan amounted to 415 million Toe, taking into account the extraction of uranium, the volume of which in the Republic of Kazakhstan amounted to about 256 million Toe.

The share of coal in the domestic consumption of energy is about 67%, oil - about 21%, gas - about 12%. Kazakhstan also has significant resources of renewable energy in the form of hydropower, solar energy, wind energy, biomass. However, in addition to part of hydropower, these resources are not widely used until the present time. The main consumer of fuel in Kazakhstan is the production of electricity and heat. The Republic of Kazakhstan has 57 power plants. On 1 January 2010 the installed capacity of power plants in Kazakhstan amounted to 19.1 thousands MW and available capacity - 14.8 thousands MW. Gaps and limitations of power amounted to - 4.3 thousands MW. About 41% of generating capacity has fulfilled more than 30 years, the number - it's 40 out of 53 thermal power plants in Kazakhstan. The total energy balance the share of thermal power plants is 88%, hydroelectric - 12%. Analysis of the structure of installed capacity of power plants in Kazakhstan shows that the UES of Kazakhstan is characterized by:

- Prevailing share of thermal power plants burning fuel as a primary carbon (75%), gas (23%) and fuel oil (2%);
- Insufficient share of hydro power plants in the electric power balance of the country.

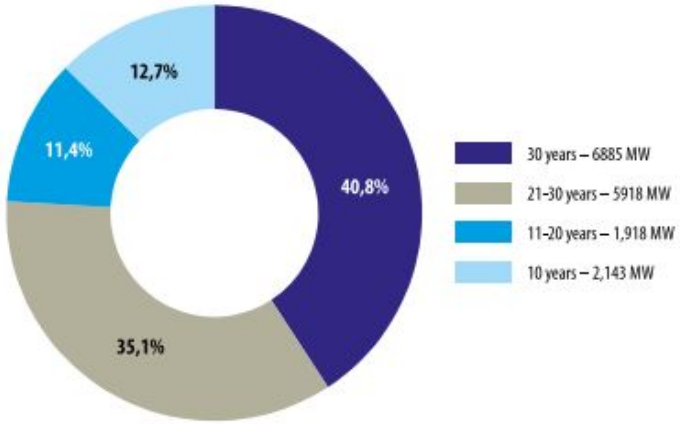
Electricity production in 2010 in the republic amounted to 82.6 TWh, electricity consumption - 83.8 TWh. Therefore, the deficit of power generation capacity of Kazakhstan to the passage of winter peak in 2010 amounted to 790 MW. Compared with 2009, production increased by 3.9 TWh or 4.9%, and electricity consumption by 5.9 TWh or 7.5%. Over the past 5 years, electricity consumption increased by 16.5%. The increase of installed capacity over the same period was only 667 MW.

Unified Power System of Kazakhstan works in parallel with the Unified Energy System (hereinafter UES) of Russia and the UES of Central Asia. At this point in the energy sector of the Republic of Kazakhstan established new market relations. The restructuring of the electricity sector was fully completed. Almost 100% of the generating units at the national level have been privatized or transferred to the

control of private companies. It created the National Electric Network and open competitive electricity market.

The problems of the power industry include: production of a significant economic life of the generating equipment, which limits the production of electricity existing power plants (TPPs national importance residual economic life ranging from 18-30%), high wear electric grid (about 65-70%), the deficit maneuvering capacity to cover peak loads due to the low share of hydropower plants (about 12%) in the structure of generating capacity, uneven distribution of generating capacity (42% of the installed capacity of UES of Kazakhstan is concentrated in the Pavlodar region). Further development of the electric power industry of Kazakhstan is impossible without modernization of existing and construction of new power plants.

Figure [2-4] Duration of CHPP operation



Source: KazEnergy, 2014

According to Strategy of Development of Kazakhstan until 2020, by 2020 Kazakhstan will produce 100% the energy from its own sources, satisfying the needs of the economy. The share of alternative energy sources in the total energy consumption will be more than 3%. Moreover, the share of gas-fired plants in electricity generation will be 20%. Kazakhstan will build and put into operation NPP and the Balkhash thermal power plant operation and create a vertically integrated company with the nuclear fuel cycle. The existing generating power capacity and distribution grid will be reconstructed and modernized.

Chapter 3 Methodology

3.1 Literature Review

Michael Porter's work "Competitive advantage of Nations" argues that national prosperity and success is created, not inherited. It does not grow out of natural endowments, labor, or national currency's value of the country; it depends on the capacity of national industry to innovate and upgrade. According to his words, nations succeed in particular industries because their national "environment is the most forward-looking, dynamic, and challenging" [Porter, 1990].

To investigate and identify why some nations achieve competitive advantage in particular industries Porter studied the experience of ten important trading nations like Germany, Korea, Singapore, United States, Japan and others. It was found that the only meaningful concept of competitiveness at the national level is productivity. Productivity is the value of the output produced by a unit of labor or capital. It depends on the quality and features of products and the efficiency with which they are produced. Moreover, Porter mentions that no nations can be competitive in everything, in every industry. To understand the competitiveness at national level, focus should be done not on the economy as a whole but on specific industries. Also

he applies four attributes that individually and as a system constitute the diamond of national advantage. These attributes are 1) Factor conditions; 2) Demand conditions; 3) Related and Supporting industries; 4) Firm Strategy, Structure and Rivalry.

Using these attributes this thesis examined the renewable energy industry of Kazakhstan.

Moreover, in the work "Australian Renewable Energy Cluster" by Ju-Hon Kwek et al. were used these four attributes in order to examine renewable energy industry in Australia. This study illustrated how Australia's natural potential with the challenges the nation will face. According to this study, Australia has the world's best natural conditions for renewable energy production and deployment, and has some of the strongest intellectual capital in this field. However, the renewable energy cluster has failed to turn good ideas into successful businesses. The opportunity remains to create the policies and environment to support competitiveness and growth for the development of renewable energy cluster.

Wei-Ming Chen et al. review renewable energy policy in Japan, South Korea, and Taiwan and provide comparative SWOT analysis for promoting renewable energy in this region. Through the SWOT analysis, this study identifies a capacity for

additional renewable energy deployment in these countries and highlights the necessity of increased cooperation between this three countries to strengthen and improvement their domestic and regional renewable energy sectors and compete in the global renewable energy market in the post-Fukushima era.

3.2 Michael Porter's model

In order to analyze the renewable energy industry in Kazakhstan first we examined the sector using Michael Porter's model "Determinants of National Competitive Advantage".

One of the conditions that allow Kazakhstan to achieve international competitiveness is not only the availability of mineral resources, but also the large number of renewable resources. According to the analysis by Michael Porter, the presence of these factors allows to create the country's competitive world-class industry. These attributes are:

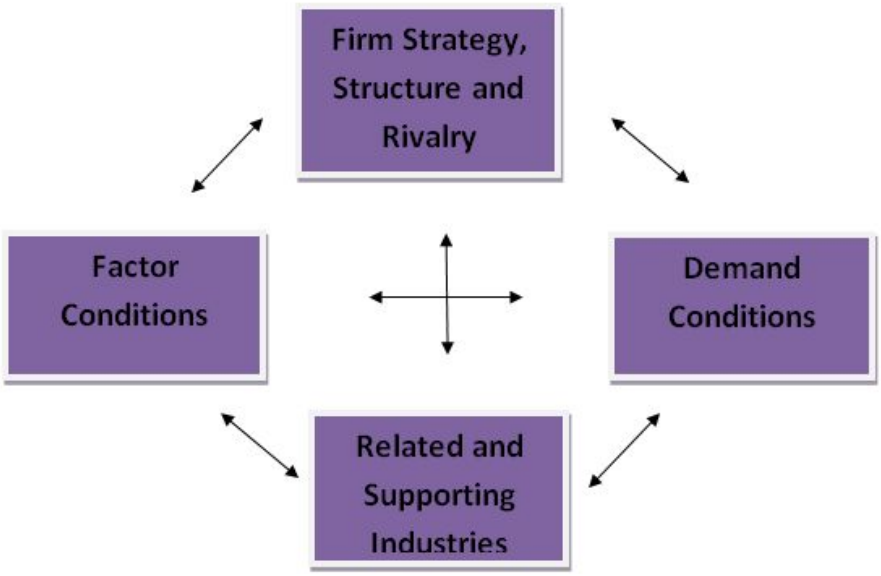
- *Factor Conditions.* The nation's position in factors of production, such as skilled labor or infrastructure, necessary to compete in particular industry. To

support competitive advantage, a factor must be highly specialized to an industry's particular needs and involve sustained and heavy investments.

- *Demand Conditions.* The nature of home-market demand for the industry's product or service. Nations gain competitive advantage in industries where the home demand gives their companies a clearer or earlier understanding what emerging buyer needs, and where demanding buyers make companies to innovate faster and achieve more sophisticated competitive advantages than their foreign rivals. Home- demand conditions help build competitive advantage when a particular industry segment is larger or more visible in the domestic market than in foreign markets.
- *Related and Supporting Industries.* The presence or absence in the nation of supplier industries and other related industries that are internationally competitive.
- *Firm Strategy, Structure, and Rivalry.* The conditions in the nation governing how companies are created, organized, and managed, as well as the nature of domestic rivalry.

Each factor effects essential ingredients for achieving international competitive success: the availability of resources and skills necessary for competitive advantage in an industry; the information that shapes the opportunities that companies perceive and the directions in which they deploy their resources and skills; the goals of the owners, managers, and individuals in companies; and most important, the pressures on the companies to invest and innovate [Porter, 1990].

[Figure 3-1] Determinants of National Competitive Advantage



3.2 Comparative analysis

Lijpart defined the comparative method as the analysis of a small number of cases, entailing at least two observations, but less than about twenty. The comparative method allows systematic comparison which, if appropriately utilized, can contribute to the assessment of alternative explanations [Lijpart, 1971].

The comparative method might often serve as a first step toward statistical analysis. Lijphart states that:

> If at all possible one should generally use the statistical (or perhaps even the experimental) method instead of the weaker comparative method. But often, given the inevitable scarcity of time, energy, and financial resources, the intensive comparative analysis of a few cases may be more promising than a more superficial statistical analysis of many cases. In such a situation, the most fruitful approach would be to regard the comparative analysis as the first stage of research, in which hypotheses are carefully formulated, and the statistical analysis as the second state, n which these hypotheses are tested as large a sample as possible.

This Comparative analysis has been done among countries with similar framework conditions in order to compare and identify the advantages and shortcomings of renewable energy industries within Central Asian countries.

3.3 SWOT and TOWS analysis

3.3.1 SWOT analysis

The general tool used in assessment of Central Asian cooperation in renewable energy and planning its further development is Strengths, Weaknesses, Opportunities and Threat (SWOT) analysis, which comes from the business management literature and was adopted in the 1980s by public administration across such areas as regional development and municipal planning. In particular, there have been examples of successful use of SWOT analysis in the field of energy planning [Terrados, 2007]

The SWOT analysis is composed using internal and external assessments. The internal assessment is conducted to show strengths and weaknesses; the external assessment is applied to discover opportunities and threats. Strengths stand for any available resources that can be used to advance the performance. Weaknesses are flaws, which may decrease competitive advantages, efficiency, or financial resources. Opportunities are external changes that could contribute and assist to an additional development and threats are outside factors that may cause problems. In the energy field, SWOT has typically been used to analyze energy industry of a single region or system [Wei-Ming Chen, 2014].

In this study, the list of SWOT is developed with the study of the existing relevant strategic and planning documents, legislation and statistics, so that the final results make us understand the reality and a set of common strategic actions. Thus, the recommendations should be appropriately developed applying the following guidance [Markovska, 2009]:

- Build on Strengths
- Eliminate Weaknesses
- Exploit Opportunities
- Mitigate the effect of Threats

3.3.2 TOWS analysis

TOWS matrix is the essential completing tool. It enhances deploying strategies considering the relations between Strengths, Weakness, Opportunities, and Threats as in SWOT analysis. The TOWS matrix helps to identify systematically relationship between threats, opportunities, weaknesses and strengths, and offers a structure for generating strategies on the basis of these relationships [Imran Aslan, 2012]

The strengths, weaknesses, opportunities, and threats are organized in a matrix that produces four combinations: SO (Strengths-Opportunities), WO (Weaknesses-Opportunities), ST (Strengths-Threats), and WT (Weaknesses-Threats). For each of these categories, potential strategies are suggested as away to address each of the four situations.

For this study, a TOWS analysis is conducted to discover:

a) How the Central Asian cooperation's strengths can help to take advantage of the emerging opportunities and minimize exposure to threats for this cooperation in renewable energy field.

b) How CA cooperation's weaknesses can be minimized and external threats can be addressed in order to fully benefit from this cooperation.

[Figure 3-2] TOWS Matrix

TOWS Matrix	**Opportunities (O)** 1. 2. 3.	**Threats (T)** 1. 2. 3.
Strengths (S) 1. 2. 3.	**SO** Strategies that use strengths to maximize opportunities	**ST** Strategies that use strengths to minimize threats
Weaknesses (W) 1. 2. 3.	**WO** Strategies that minimize weaknesses by taking advantage of opportunities	**WT** Strategies that minimize weaknesses and avoid threats

3.4 Input Data

In order to evaluate and assess the development of the renewable energy market in Kazakhstan and to identify barriers for its further development, the following data and indicators have been collected from various sources (books, articles, reports, government data base).

<Table 3-1>Information collected for the analysis of renewable energy market and its development

Topic	Information	Source
Energy supply	• Primary energy sources; • Energy balances of the country (primary energy sources, electricity, heating); • Electricity production and heat supply; • Installed power generation capacity and technologies in use	• Ministry of Energy • World Bank • IEA • KazEnergy
Energy demand	• Demand of primary energy; • Electricity demand	• Ministry of Energy • KazEnergy • KEGOC

Renewable Energy	• Deployment for renewable energy sources for electricity production (installed capacity/technologies used/yearly production); • Estimated potential for renewable energy sources; • Current regulatory framework for renewable energy sources; • National and regional targets for renewable energy sources; • Incentives structure and volume; • Initiatives and programmes	• Ministry of Energy • KazEnergy • UNDP • IEA • Legal information system "Adilet" http://adilet.zan.kz/eng • World Bank • http://www.atlas.windenergy.kz/ • REN 21

Information collected for the SWOT Analysis

The following data and indicators have been collected from various sources (books, articles, reports and government data base) in order to identify strengths, weaknesses, opportunities and threats of Central Asian cooperation on renewable energy development:

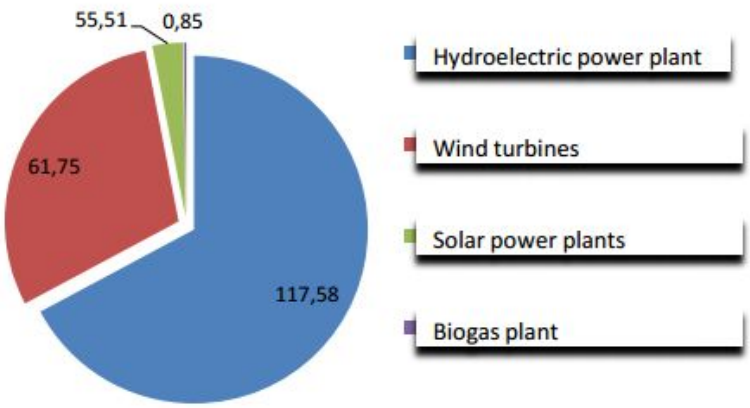
- The existing generation capacity
- Domestic demand in the countries
- Forecast for electricity demand
- Regulatory framework
- Energy demand and supply

Chapter 4 Renewable Energy in Kazakhstan

4.1 The current situation

Kazakhstan possesses significant renewable energy resources such as hydropower, solar, wind and biomass. However, with the exception of hydropower, these resources are not widely used until the present time. Generation of electricity from renewable energy sources amounted to 0,57 TWh in 2014. Today in the Kazakhstan there are 44 objects of renewable energy with a total capacity 235.69 MW (Solar power plants - 55.51 MW (in Almaty, South Kazakhstan and Zhambyl regions), Wind power plants - 61.75 MW (in Akmola, North Kazakhstan and Zhambyl regions), Hydro power plants - 11758 MW (in Almaty, East Kazakhstan, North Kazakhstan and Zhambyl regions), Biogas power plants - 0.85MW (Kostanay region).

Figure [4-2] Renewable Energy Installations (2015.07.01)



(Source: Ministry of Energy of Republic of Kazakhstan)

<Table 4-1> Share of renewables in the energy balance of Kazakhstan

Index	2008	2009	2010	2011	2012	2013	2014
The volume of electricity generation from RES, billion kWh	0,32	0,38	0,4	0,42	0,45	0,531	0,573
The share of renewable energy in total energy consumption , %	0,39	0,48	0,48	0,48	0,5	0,59	0,62

(Source: Ministry of Energy of Republic of Kazakhstan)

Hydro energy

In view of the energy generated in large hydro power plants, the share of renewables in the energy balance of Kazakhstan is about 12.3%.At the moment, from renewable energy sources the country is using small hydro as well. In accordance with the state program for accelerated industrial-innovative development of Kazakhstan for 2010 - 2014 years, by 2015 is planned to put into operation new small hydro power plants with a total installed capacity of 100 MW, with planned production of electric energy – 0,3 TWh.

Wind Energy

Currently, government studied 10 sites for the construction of wind power plants in Kazakhstan. All of these sites can be used for the construction of large wind farms with a total capacity of 1000 MW for the commercial production of electricity in the amount of 2-3 TWh.

With the support of the state there are will be built WES: near Shelek corridor with installed capacity of 51 MW; near Zhungar gate (50 MW in the first phase); in Ulan district of East Kazakhstan region (24 MW) and some others.

It is planned to implement projects for the construction of the first wind farm. By placing prospective areas include Astana, Akmola region, Jungar Gates and

Chilik corridor - in the Almaty region. Estimated power generated electricity in the first phase could reach 50-100 MW.

It should be noted that in March 2011 in Zhambyl region of Kazakhstan has launched major projects - Zhanatass (400 MW) and Shokparsk (200 MW) wind energy systems (WES). The amount of investment on their construction is about $ 1 billion.

Solar Energy

As part of the innovative development program of Kazakhstan, the Program of modernization of the electricity sector of the Republic of Kazakhstan and international project Green Village, which oversees the United Nations in the area of Almaty (in the village Sarybulak Almaty region) at the end of June 2012 was put into operation a solar electric power station. The object with value of 580 thousand dollars was built in 2010 under an agreement between Kazakhstan and the Republic of Korea with grant funds of foreign partners. The organizers of the construction were the city administration of Almaty region JSC "Dostyk Energo", the South Korean corporation

"Daesung Energy" and the Agency “KOICA”[5].

The power plant consists of a 6-twenty meters of solar panels, accumulating solar energy. Solar plant covers an area of one hectare. The project capacity of alternative generating enterprises exceeds 52 kilowatt-hour of electricity. Only two local staffs manage the installation, which have been trained in Korea.

With emergence of solar power in the village, it became possible to drill wells to obtain the artesian water. Today, drinking water comes from a depth of 130 m. According to residents of the village, their welfare and consumption levels in recent years have increased significantly.

Despite its considerable potential, the development of solar generation has a number of material constraints, one of which being the high cost of the electric energy generated by solar power plants, which are attributable to the considerable capital investments. Solar power plant operation depends on weather conditions, and changeable can have an extreme effect on power generation parameters. As a result, electric energy generated by SPPs is amongst the most expensive in comparison with

[5]http://daesunggroup.nanuminet.co.kr/en/html/sub05_02.asp?page=7&seq=6537&Search=&

other industrial generation methods.

Despite the above disadvantages, the construction of solar power plants could be recommended at this stage in order to gain SPP operational experience, develop Kazakhstan's raw material base (according to certain estimates, the RK's silicon reserves are equal to 250 mln. tons) produce of photovoltaic modules, and supply energy heat to remote consumers.

At present Kazakhstan has its own photovoltaic module production facilities (a project developed by JSC “NAC “Kazatomprom” KAZ PV). The goal of this project is the diversification of JSC “NAC “Kazatomprom's” activities through the creation of plants for the production of photovoltaic plates and modules using 100% Kazakh produced silicon. The project has been implemented on the basis of the transfer of advanced French technology and it has made possible the creation of a production cycle comprising the following enterprises and stages:

- LLP “MK “KazSilicon” (Ushtobe, Almaty region) - gangue quartz mining and processing in Sarykul field (Ushtobe, Almaty region), metallurgical grade silicon production;

- LLP “Kazakhstan Solar Silicon” (Ust-Kamenogorsk) - refinement of metallurgical grade silicon to “solar” purity (99.98%), production of "solar" purity silicon ingots, ingot saw-cutting into blocks, block saw-cutting into plates, production of photovoltaic plates;
- LLP “Astana Solar” (Astana) - photovoltaic module assembly plant, the foundation of a scientific-research base for R&D in the area of alternative energy sources. LLP “Astana Solar” plant was launched on the 25th of December, 2012 with a design output of 230 thousand photovoltaic modules with an aggregate capacity of 50 MW/year. The modules are manufactured using French Semco Engineering technology.

4.2 Potential of Renewable Energy

According to expert estimates of the Ministry of Energy, the potential of renewable energy in Kazakhstan is very significant and is about one trillion kilowatt hours per year, which is significantly (more than 10 times) higher than the power consumption in the country. At the second international business conference of the Asian Society, held in 2008, the Ministry of Energy estimated the potential of the country to more than 2.7 trillion kW.

According to the Ministry of Energy, the proportion of alternative energy sources to total electricity generation in 2010 was only 0.03% and 0.46%, including small hydro power plants[6].

Hydro energy

In reserves of hydropower resources Kazakhstan is on third place in the CIS after Russia and Tajikistan. Taken as a whole, hydro-energy is the most promising RES development option, since hydro-energy stations provide a comparatively constant output of electric energy with low production costs and a long economic life (up to 80 years). Kazakhstan has about 2,000 rivers and water courses with more than half of them in the territory of South Kazakhstan. According to preliminary estimates, 5% of river flows are suited for the construction of small HPP (with a unit rating below 30 MW). Water and water-power resources of the country are distributed irregularly throughout its territory, most of them are concentrated in the eastern and southern regions of the country, on the Irtysh, Ili and Syr-Darya rivers (73% of all water resources):

[6] Ministry of Energy of Republic of Kazakhstan, http://en.energo.gov.kz/

- In the eastern zone, in the Irtysh river basin with Bukhtarma, Uba, Ulba, Kurchum, Kuldzhir confluents;
- In the south-eastern zone, in the Ili river basin, which is fed by rivers flowing from the Zailiyskiy Alatau mountains (Kaskelen, Aqsay, Turgen, Chilik, Charyn), and also in the basin of east Balkhash and Alakolsk group of lakes that are fed by rivers flowing from Dzungarian Ala Tau (Koksu, Karatal, Aksu, Lepsy, Tentek);
- In the southern zone, in Syr-Darya basins and the Talas and Chu rivers.

<Table 4-2>Hydro power potential

Energy zone	**Hydro economic region**	**Administrative units**	**Water power resources**		
			estimated / technical / economic		
			Small HPP	Medium HPP	TOTAL
			installed capacity	installed capacity	
			<10 MW	from 10 to 35 MW	
North	East Kazakhstan	East Kazakhstan province	16/5.6	56/21	72/27

South	South-East Kazakhstan	Almaty region	27/10	45/19	72/29
North	South Kazakhstan	Jambyl, South-Kazakhstan, Qyzylorda regions	16/4.2	4/1	20/5.2
West	North, Central, West Kazakhstan	Other regions	6/1.2	0/0	6/1.2
Total Kazakhstan			65/21/7.5	105/41/22.5	170/62/30

(Source: Kaz Gidro, Almaty, 2010)

Kazakhstan's estimated water potential is fairly high and according to "KazGidro" LLP it is equivalent to 170 TWh / year. The country's water-power potential, which is technically feasible for industrial use comes to about 62 TWh / year, including 7.84 TWh / year suitable for small HPPs (with installed capacity of 10 MW). At the moment only 8 TWh / year is used, of which only 0.36 TWh / year used for the operation of small HPPs. According to pre-project and project designs, the potential opportunities for water-and-power use (new construction and renovation) are estimated at 3.7 GW of installed capacity [KazEnergy, 2013].

Today, the share of hydroelectric power plants in the structure of generating

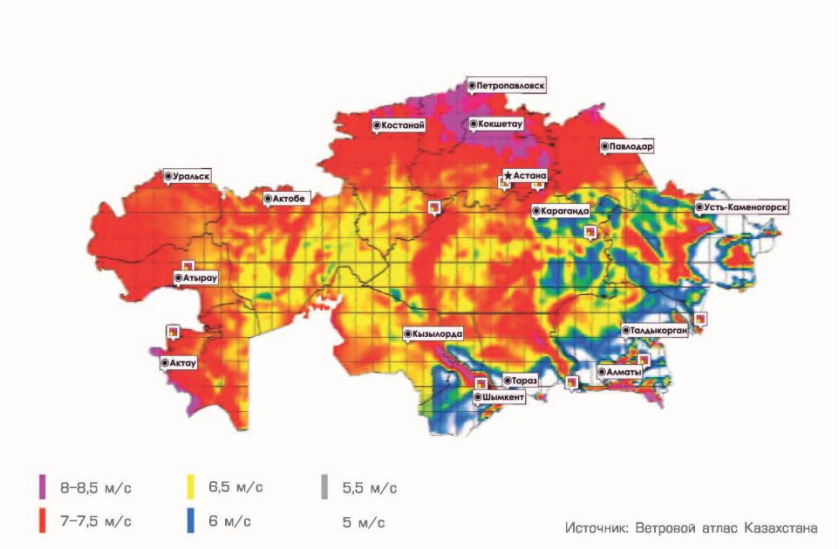
capacities in Kazakhstan is only about 12.3%. This figure is far behind the developed countries. Moreover, 68% of the generating capacity of hydroelectric power plants worked more than 30 years. Certain progress will bring in the coming years the implementation of several major hydroelectric projects: Moinak hydroelectric installed capacity of 300 MW hydroelectric Kerbulak - 49.5 MW Bulak HPP - 68.25 MW. Despite the considerable potential of large hydro, Kazakhstan can successfully learn from the development of mini-hydro, which was partially tested during the Soviet period. It is significant that the economic potential of small hydro power plants, estimated to reach about 7.5 TWh/year. Based on the results of the research potential can be realized, at least 480 projects of small hydropower plants with a total capacity of 1868 MW (8510 GWh average annual generation capacity of electricity). Some of them involve the use of existing irrigation channels, which requires less resources, time and resources for their implementation.

Wind Energy

In the republic the potential of renewable wind energy is the most significant of all. It is theoretically possible capacity is estimated between 0.929 to 1.82 TWh per year. Economic opportunity is 3 TWh per year. Comparing the assessment of wind

potential with the amount of energy consumption in the Republic, we can see that only wind power can provide electricity to 10 - 20 times more than its necessary for Kazakhstan. Promising areas for development of wind energy are Almaty region, (Jungar Gates, Chilik corridor), Akmola region (Yerementau), Zhambyl region (Kordai) and other regions. Studies conducted in the framework of the UNDP project on wind power, show the presence of a number of areas of Kazakhstan with a total area of about 50 thousands sq. km with average wind speed of 6 m / s. It makes them attractive for the development of wind power. In Dzhungar Gates it is possible to construct the wind power station with over than 1000 MW (1 GW) total capacity, in Shelek corridor – up to 1 GW. One of the reasons for the complexity of developing the Dzungarian Gates wind energy potential is the turbulence of the wind and its considerable velocities, which can exceed 70 m/s.

[Figure 4-3] Wind atlas[7]



<Table 4-3>Wind potential

Wind category	Low	Average	High	Higher	Excessive	Total
Wind speed range	< 6 m/s	6 - <7 m/s	7 - < 8 m	8 - <9 m/s	> 9 m/s	

[7] http://www.atlas.windenergy.kz/

			/ s			
Wind zone area, sq. km	1,795,140	876,900	50,500	1,200	200	2,723,940
Share participation, %	65.902 %	32.192%	1.854%	0.044 %	0.007%	100%
Specific density, MW/sq. km	2	4	7	10	14	7,466,300
Wattage, Mw	3,590,400	3,507,600	353,500	12,000	2,800	1,888
Annual average number of hours used	1,700	2,000	2,628	3,200	4,200	14,098
El. energy generation, TW*h	6,103.68	7,015.2	929	38.4	11.76	14,098.04
Percentage rating of territory usage by different wind zones, %	43.295 %	49.760%	6.590%	0.272 %	0.083%	100%

(Source: based on the data from UNDP project “Kazakhstan – wind energy market development initiative”)

Solar Energy

Kazakhstan has an abundance of solar radiation due to its geography and its relative elevation above sea level. It receives on average of 6.5 to 6.8 hours of sunlight per day. Annual total daily irradiation varies between 3.5 and 4.6 kilowatt hours per square meter, which is among the best potential in the world. The southern areas of the country are most favorable for the use of solar energy. Potential possibilities of solar power are estimated at 2.5 billion KWh per year. Despite the fact that Kazakhstan is located on the northern latitudes, the potential of solar radiation on the territory of the republic is quite significant (1.3-1.8 thousands KW / h per 1 sq. meter per year, the number of hours of sunshine a year - 2.2 -3 thousands).

In addition to electricity generation solar energy can be efficiently used for heat generation as well. Taking into account the country's climatic conditions and insolation values, the introduction of solar water heating systems (collectors) would be promising in the central and southern regions of Kazakhstan. In locations where is no cheap sources of external heat supply, the use of solar collectors to warm up water for household usage could be economically and technically feasible.

4.3 Renewable Energy Targets and Policies

In the State program for accelerated industrial-innovative development of Kazakhstan for 2010 - 2014 years, as well as in the State program of industrial-innovative development of Kazakhstan for 2015-2019 years, noted that one of the priority directions of development of electric power industry and solving environmental problems of Kazakhstan are the use of renewable energy resources. The potential of renewable energy resources (hydro, wind and solar energy) in Kazakhstan is very significant. Therefore, the main task is to increase the share of renewable energy sources (small hydroelectric, solar and wind installations) in the country's energy balance. The strategy of efficient use of energy and renewable resources of Kazakhstan for sustainable development up to 2024 should include the following steps:

- The preparatory phase (2008-2009) - preparation of conditions for the effective use of renewable resources and energy sources, generalization and systematization of international best practices, the development and improvement of the legislative framework, the creation of preconditions for the state to stimulate the efficient use of resources and energy;

- The first phase (2010-2012 years) - the introduction of government measures to stimulate the use of renewable resources and energy sources, energy and resource saving technologies, research and development of policy documents, improving the system of training and re-training, technology transfer through participation in the activities of enterprises, attracting investments and "know-how";
- The second phase (2013-2018 years) - pilot projects in all regions of the country, the development of integrated energy systems, reducing the share of thermal power, further research and technologies in the field of energy and resources;
- The third phase (2019-2024 years) - the formation of industries on the basis of renewable resources and energy, the spreading of positive experience, including in the countries of Central Asia, the transition to a "breakthrough" energy technologies.[8]

[8] The strategy of efficient use of energy and renewable resources of Kazakhstan for sustainable development until 2024, approved by the Government of the Republic of Kazakhstan dated January 24, 2008 N 60

In order to support the use of renewable energy sources, on July 4, 2009 Kazakhstan adopted the Law "On supporting the use of renewable energy". Law established legal, economic and organizational basis for promoting the use of renewable energy sources for the production of electricity and heat, and determine the measures to support them. The Act provides a number of measures to support renewable energy sources, including:

- Reservation and priority in the allocation of land plots for the construction of renewable energy sources;
- Commitments of power transmission companies for the purchase of electricity produced from renewable energy sources;
- Fees exemption for the transportation of electricity;
- Support for connecting renewable energy facilities to the grid power transmission companies;
- Investment preferences to individuals and legal entities engaged in the design, construction and operation of renewable energy. In particular, the law provides the granting of investment incentives for renewable energy projects, prioritize the use of "clean" electricity market and its transmission

through the network, as well as support through a system of certificates controlled by state;

- Government ensures to the individual users the compensation of 50% of the costs for the acquisition of units of renewable energy sources.

Moreover, in order for further development of RES and exchange of experience with the world community, Kazakhstan has acceded to the International Renewable Energy Agency and ratified its charter made in Bonn on 26 January 2009[9].

March 21, 2013 President Nursultan Nazarbayev signed the Law of the Republic of Kazakhstan "On Ratification of the Statute of the International Agency for Renewable Energies (IRENA)", thus providing access to scientists and specialists of the country to new renewable energy technologies.

In accordance with the Strategic Plan of Development of Kazakhstan till 2020 the share of alternative energy sources in total energy consumption should reach 1.5% by 2015, and more than 3% - in 2020. In accordance with national programs for the transition to sustainable development, the share of renewables in the energy balance of

[9] The RK Law « On the ratification of the Charter of the International Renewable Energy Agency (IRENA) », No. 82-V ZRK dated 22 March 2013.

Kazakhstan will increase to 5 percent by 2024, and achieve a 10% share of renewable energy in total energy production by 2030. Projections of renewable energy installed capacity in 2030 are 4.6 GW for wind power plants and 0.5 GW for solar power plants.

According to the updated Action Plan for the development of alternative and renewable energy in Kazakhstan for 2013-2020, before the end of 2020 it is planned to put into operation about 106 renewable energy facilities (more than 4.5 billion US dollars investments) with a total installed capacity of 3054.55 MW, including:

- Wind power plants – 34 (1787 MW);
- Hydropower plants – 41 (539 MW);
- Solar power plants - 28 (713.5 MW);
- Biomass power plants - 3 (15.05 MW).

In order to attract investments for development of renewable energy, legislation provides the following basic support mechanism for investors:

- Investors are guaranteed the purchase of the total volume of renewable energy at a fixed rate for 15 years;

- Fixed rates are subject to annual indexation for inflation; In June 2014 approved the following rates (KZT / kWh, excluding VAT): wind - 22.68; solar - 34.61; small hydro - 16.71; biogas - 32.23;
- Fixed tariffs approved by the Decree of the Government of the Republic of Kazakhstan (№ 645 from 12.06.2014) and cannot be changed for 3 years;
- The buyer of electricity from renewables is Regional Financial Center (RFC), created by the KEGOC;
- Renewable energy producers are exempt from payment for the transportation of electricity;
- Financial settlement of imbalances from renewable energy is made by RFC;
- The transmission and dispatching of electricity produced from RES is given priority;
- Power transmission companies cannot refuse to connect renewable energy facility because of unavailability of the network;
- The cost of the reconstruction and expansion of the network carries by power transmission companies;

- The expenses of connection to the network are paid by owner of renewable energy facility.

Moreover, in order to promote the further development of renewable energy, Kazakhstan will host the exhibition "EXPO-2017" under the theme of Future Energy - a fair devoted to promoting renewable energy alternatives and technologies. A Centre for Future Energy, promoting similar issues, is also in the process of being established in Kazakhstan.[10]

[10]Kazakhstan UNSC ENERGY SECURITY IN KAZAKHSTAN – POWERING THE FUTURE October 2014

Chapter 5 Development of Renewable Energy in Other Central Asian Countries

Central Asia comprises five countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Central Asian countries have a notable potential for renewable energy resources.

This chapter discusses the energy status of each state in CA, including the potentials of renewable energies. Each state has a different potential in terms of different types of renewable energy sources, depending on natural and social-economic conditions.

5.1 Kyrgyzstan

The basis of modern power system of the country was formed during the Soviet era, when it was part of a regional (Central Asian) system, where the dominant source of energy is the energy of the water (hydropower plant in Kyrgyzstan and Tajikistan), as well as additional sources of energy to use fossil fuels imported from Kazakhstan, Turkmenistan and Uzbekistan.

The complexity of the current situation in the energy sector of Kyrgyzstan is

caused by the fact that the basic generating sources (the largest 5 hydroelectric power stations, which account for 90% of the total installed capacity of power equipment) are concentrated in the central and southern regions, and the main buyers (60%) - in the north of the country. At the same time the electricity is transported in part on the territory of Kyrgyzstan, and the rest of the flow is looped through Uzbekistan, Kazakhstan and Tajikistan.

Specific conditions of Kyrgyzstan, where about 90% of the country covered by mountains and more than 60% of the population lives in the foothills and mountainous areas, where traditional fuel delivery is difficult, creates prerequisites for active use of local autonomous systems on renewable energy.

According to expert estimates the annual technical potential of solar heating installations in Kyrgyzstan may reach 1.7 million MJ, but the economic potential is estimated just over 26 thousand MJ per year.

Wind energy is estimated at approximately 2 TWh. However, a considerable part of the plain and foothill areas, where most of the population, the potential of wind energy is low.

The magnitude of potential water resources (142 TWh) Kyrgyzstan occupies 3rd

place in CIS after Russia and Tajikistan. As of 2012 this resource (large hydro) was employed for not more than 10%, and hydro potential of small rivers - about 3%.

There are 20 geothermal energy can be used for heating and hot water, mainly in recreational areas of Issyk-Kul region.

There is the possibility of using agricultural waste. However, the level of use is extremely low and is usually limited to heating of premises with dry manure

Kyrgyz National Energy Program for 2008-2010 and the strategy for the development of fuel and energy complex till 2025, approved by the Decree of the Government of the Kyrgyz Republic on February 13, 2008 №47 provide for the further development of this type of renewable energy.

Small hydropower is today one of the important areas that the Government of the Kyrgyz Republic intends to develop a sustainable supply to consumers and to reduce greenhouse gas emissions. The main objective of the project United Nations Development Program and the Global Environment Facility “Small Hydro Power Development”, implemented in Kyrgyzstan, is to accelerate the construction of small hydropower plants and biogas plants, solar water heaters and power plants, wind turbines.

5.2 Tajikistan

The country is among the top ten countries in the world (8th place), has the largest hydropower potential. Before the collapse of the Soviet Union, in Tajikistan there was built 15 hydropower plants with a total installed capacity of about 5 GW (currently, for technical reasons the figure is close to the mark of 3.5 GW). These HPP was used not only for power generation, but also for irrigation purposes.

Total domestic electricity consumption in 2011 amounted to 16.2 TWh. The share of renewable energy in the total energy consumption is 0.07% (120 900 thousands kW h). Electricity shortage is 4 TWh.

The national structure of power generation at hydro power plants accounts for about 98%, CHP -2%; average annual production stands at 16.5 billion kWh.

In general, the country is experiencing serious difficulties with power shortages (introduced limits on its consumption, especially in the winter), the preservation of which is due largely limited domestic financial capabilities of the country, capital-intensive modernization and construction of large hydropower plants, the production of alternative energy, the construction of new transmission lines, including for electricity exports.

In 2009, the president issued a decree "On additional measures for energy conservation," and in 2011 on its base was developed "Program for efficient use of hydropower resources and energy efficiency for 2012-2016", which in addition to other specified such industry trends, as the widespread use of alternative energy sources.

The focus of the program is given to the construction of power plants generating renewable energy, primarily from hydro. According to the program the amount of electricity to small hydro power plants in Tajikistan, with full use of hydropower resources of small rivers will reach 184.46 TWh per year, with installed capacity of 21 057 thousands kWh.

Long-term program of construction of small hydropower plants involves three steps:

- The first stage of the duration of 3 years from the implementation period 2009-2011. It involves the construction of 66 small hydropower plants with a total installed capacity of 43530 kW;
- The second phase of 4 years from the implementation period 2012-2015. - 70 stations with a total installed capacity of 32,850 kW;

- The third stage duration of 5 years from the implementation period 2016-2020. - 53 stations with a total installed capacity - 26801 kW.

5.3 Turkmenistan

Currently, the country's domestic demand for electricity is fully guaranteed by the use of its own facilities. In 2012-2013, the country has developed a "National Strategy of Turkmenistan on climate change", according to which in the future will be created by the "Action Plan", which contains measures both to combat climate change and adapt sectors of the economy to the relevant changes. It is expected that the Plan will apply to all sectors of the economy, however, will focus on its core segments (industry, transport and housing), and priorities will be the following: the introduction of energy-efficient and energy-saving technologies; development of the sphere of renewable energy; technological modernization in order to ensure the future development and competitiveness of the economy.

For successful implementation of the objectives outlined by the government:

- Development of a national law on energy saving;
- Improving the regulatory framework;
- Creation of a special state body responsible for the sector of energy saving;

- Development of a national program for energy conservation;
- Develop a strategy for renewable energy development;
- Providing tax incentives for investors in the sector of renewable energy sources;
- Exemption from import duties of organizations in the renewable energy equipment.

Thus, Turkmenistan has embarked on the creation of energy efficient and green economy.

Renewable energy potential of Turkmenistan is estimated at 110 billion Toe in year. The most promising renewable energy sources are solar and wind energy.

Turkmenistan has a high potential for wind energy (640 billion KWh per year). The most favorable conditions for the development of wind power have the western and north-western regions of the country (including the Caspian area). Currently, however, there is no existing wind farm. The potential of solar energy is estimated at 1.4 billion Toe in year.

5.4 Uzbekistan

Uzbekistan has significant potential for renewable energy, of which about 99% comes from solar energy. According to estimates, the gross potential of renewable energy is about 51 billion Toe, technical - 179 million Toe. Currently, only 0.6 million Toe disbursed (0.3%) of the technical capacity through the use of hydropower of natural and artificial reservoirs.

The potential of solar energy are estimated at 176.8 million Toe, of which only 0.6 million toe disbursed. The total area of installed solar collectors is about 40 thousand sq. M. m.

The potential of wind energy is 0.5 million Toe. The main raw materials for biomass are cotton stalks and agricultural waste. Hydro resources, 650 rivers flowing through the territory of Uzbekistan, numerous irrigation canals and reservoirs, provide a high potential for construction of small hydropower plants.

At the moment, renewable energy accounts for about 1% of total energy consumption. Efforts are being made for the development of scientific and industrial potential in the field of renewable energy, including research and experimental-industrial development in the field of alternative energy sources, practical use, taking

into account the world experience, as well as the organization of domestic production of advanced equipment and technologies for this sector.

Uzbekistan draft a law on renewable energy sources, a law on alternative energy sources, the Concept of the Republic of Uzbekistan for the development of alternative fuels and energy for 2012-2020 and the State program "The prospect of fishery products on alternative energy sources and fuels for 2013-2020 years."

Chapter 6 Competitiveness Analysis on Renewable Energy Industry in Kazakhstan

6.1 Application of Michael Porter's approach

What is the definition of competitiveness? The Global Competitiveness Index 2014-2015 define competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country[11].

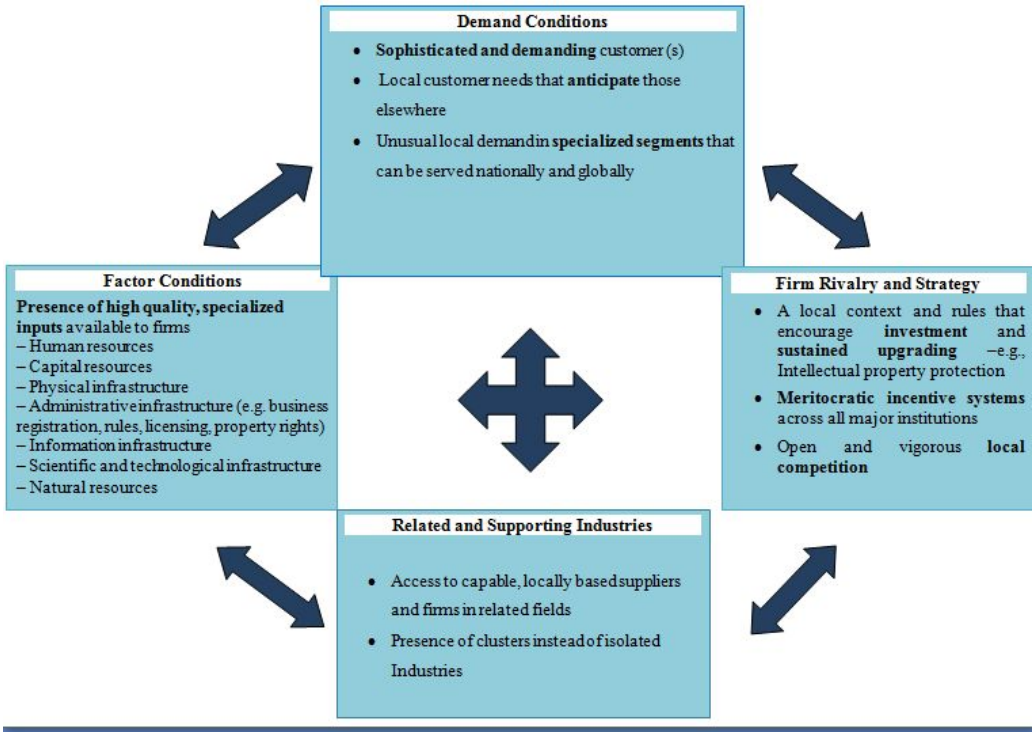
Many determinants drive productivity and competitiveness. Understanding the factors behind this process has occupied the minds of economists for hundreds of years, engendering theories ranging from Adam Smith's focus on specialization and the division of labor to neoclassical economists' emphasis on investment in physical capital and infrastructure and, more recently, to interest in other mechanisms such as education and training, technological progress, macroeconomic stability, good governance, firm sophistication, and market efficiency, among others [World Economic Forum, 2014]. According to The Global Competitiveness Report 2015–2016, Kazakhstan takes 42nd position.

According to Michael Porter, a nation's competitiveness depends on the capacity

[11] http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf

of its industry to innovate, develop and upgrade. There are ingredients of competitive success, known as a system of Determinants of National Competitive Advantage or "diamond". It includes

[Figure 6-1] Diamond of Competitive Advantage [M. Porter, 2005]

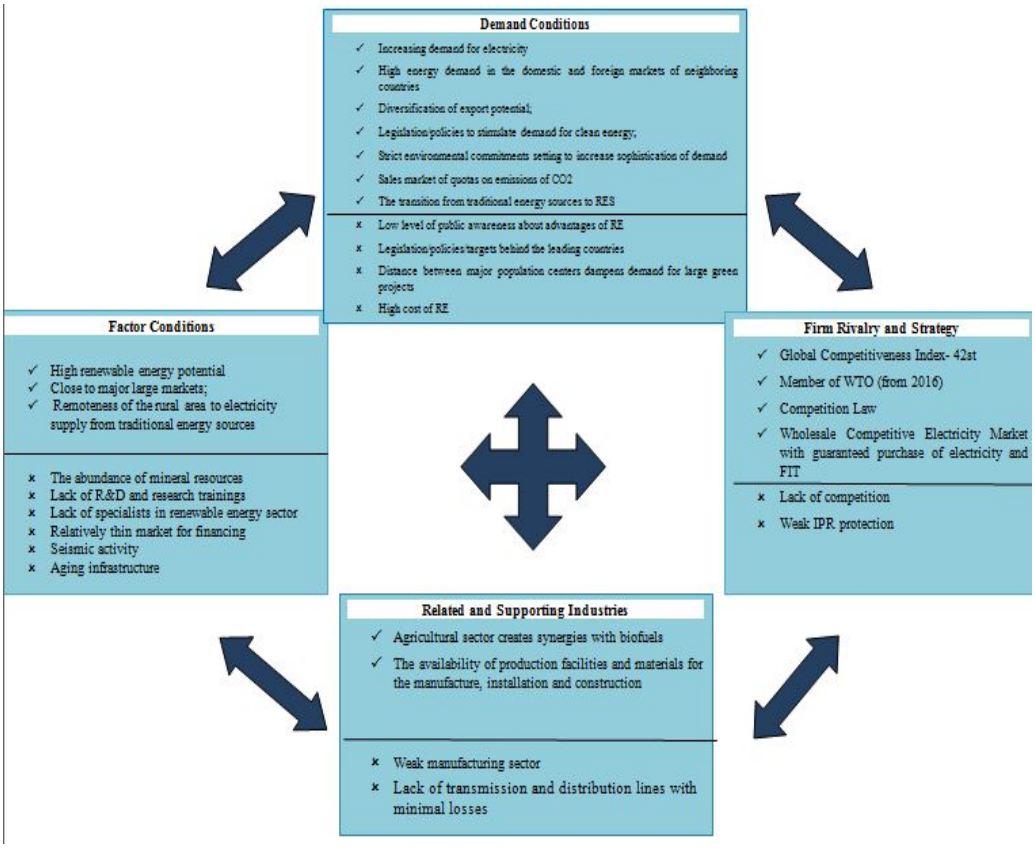


Each point on the diamond affects important components for achieving competitive success: the availability of resources and skills necessary for competitive advantage in an industry; the goals and targets of the managers and individuals; the pressures of national environment on companies to invest and innovate [Porter, 1990].

This model was used in order to assess the competitiveness of renewable energy industry of Kazakhstan. Each point of the diamond was applied to examine the competitiveness of Kazakhstan's Renewable Energy Industry identifying its strengths and weaknesses.

A summary of the Kazakhstan renewable energy Industry diamond is shown in Figure 6-2:

[Figure 6-2] Diamond of Renewable Energy Industry of Kazakhstan



Within the framework of the diamond model, "factor conditions" is the most significant driver of the Kazakhstan renewable energy Industry's current predicament. Kazakhstan has one of the world's best natural conditions for renewable energy production, but at the same time possesses rich mineral resources endowments which create a strong disincentive for investments in the renewable energy sector.

6.2 Factor Conditions

Strengths:

a) *High renewable energy potential*

• Wind energy (929 TWh per year);

• Hydro energy (total hydro - 170 billion KWh per year, technically feasible to implement - 62 TWh per year, of which about 8 TWh per year is the potential of small hydro power plants);

• Solar energy (photovoltaic installations and solar collectors, solar energy potential is estimated at 2.5 TWh per year; the development of solar energy contributes to the world's largest reserves of silicon feedstock (85 million Tons)).

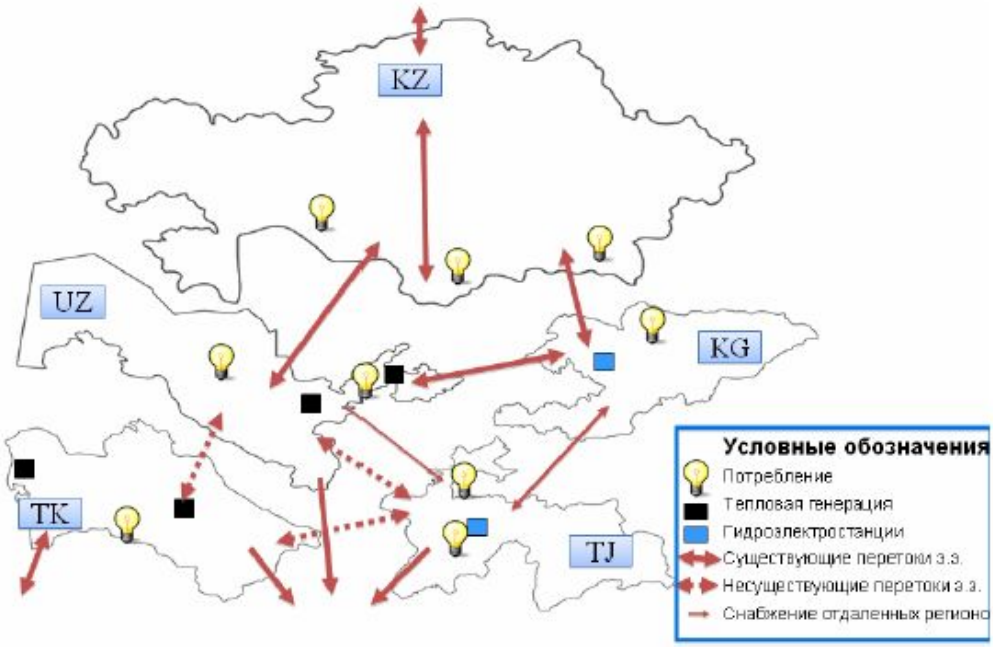
The total potential of renewable energy is very significant and estimated at more than $ 1 trillion kWh / year.

b) *Close to major large markets;*

Unified Power System of Kazakhstan works in parallel with the United Energy System of Central Asia and Russia. The power systems of Central Asia

working in parallel on the basis of the "Agreement on the parallel operation"[12], signed by the member states in 1998 (see Figure 6-3).

[Figure 6-3] Central Asian Power System



c) *Remoteness of the rural area to electricity supply from traditional energy sources;*

Weaknesses:

[12] Parallel operation of several power systems - a kind of work in which:
• maintain the same frequency in all power systems in the region;
• coordinating and preliminary calculation modes;
• Grid interconnected via existing power lines.
When the joint operation of power systems, it is possible to determine the operating modes which optimize system costs (which total system costs include the costs of operating the network and new investments in network and generation). The above optimization can be controlled internally or be achieved through market-based instruments (when the scheduling is determined on the basis of price bids of each individual power plant).

a) *The abundance of mineral resources* is one of the major obstacles for the development of renewable energy sources. The situation became complicated by the fact that the production of energy from fossil fuels is largely subsidized, both directly and indirectly.

In Kazakhstan, alternative energy cannot have wide industrial development because the country has sufficient resources of natural fuels (coal, oil, gas) for years to come. This is the main thing that hinders the development of renewable energy sources.

b) *Lack of R&D and Research Trainings. Lack of specialists in renewable energy sector.*

The factors limiting Kazakhstan's scientific development are primarily associated with a lack of qualified personnel, a lack of testing facilities and an inflexible system of scientific research funding. Kazakhstan has limited human, technical resources, so investments in science should be made to address the most pressing problems in the country.

c) *Relatively thin market for financing*

A well-functioning financial sector is a key to effectively intermediating commodity revenues toward non-resource sectors and SMEs with high investment potential. The factors that slow down the development of renewable energy in Kazakhstan include the general inaccessibility of credits for investments (because of the persistence of high interest rates).The development of small and medium-sized enterprises remains constrained by lack of access to finance, in particular in the regions and in local currency at maturities that meet the needs of SMEs. The banking sector is hampered by a high level of non-performing loans [EBRD, 2013].

d) *Adverse wind conditions;*

The wind power potential of one Dzungarian Gates only, by optimistic estimations over 1 trillion kW-hours a year. However this production can be complicated because of extreme wind.

e) *Seismic activity;*

Kazakhstan is characterized by high seismic activity, especially in south part[13]

[13] http://earthquake.usgs.gov/data/russia_seismicity/regionalcatalogs/kazakhstan.php

f) Water supply

Despite the considerable potential of water resources and existing hydro energy development plans, there exist significant risks for Kazakhstan in this sector in the foreseeable future due to the fact that 1) country is highly dependent on cross-border rivers that flow from China, Russia, Uzbekistan and Kyrgyzstan which account for 44% of the country's surface water flow; 2) the onflow (primarily from China) is being reduced rapidly due to its significant use of its water resources. According to the forecasts, the onflow of cross-border rivers may dwindle by 40% by 2030.

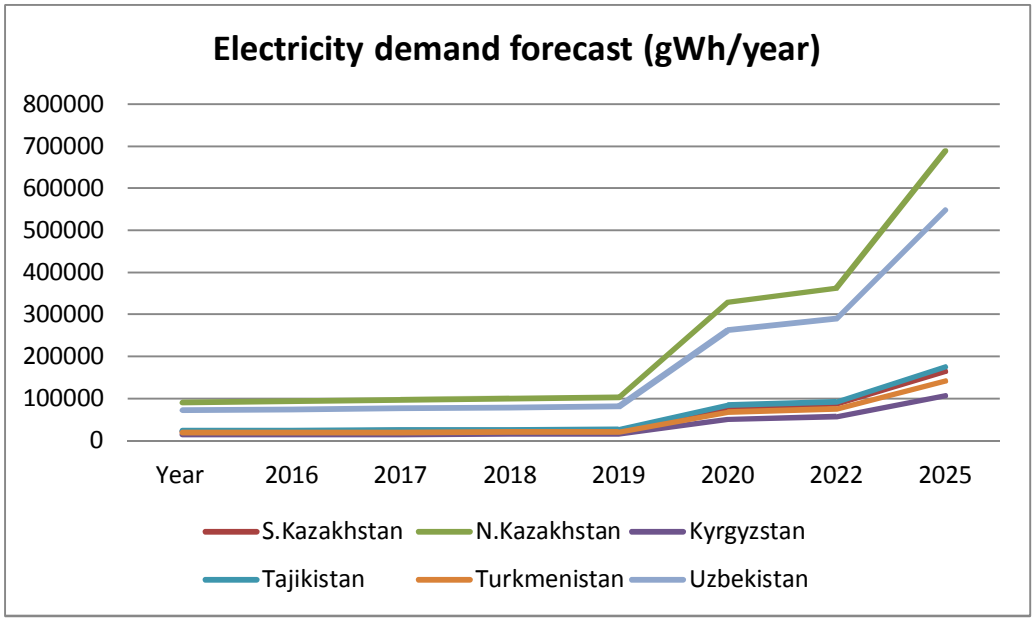
6.3 Demand conditions

Strengths:

a) Increasing demand for electricity

The Figure 6-4 “Electricity demand forecast untill 2029” illustartes the increase the level of electricity demand not only in Kazakhstan, but in other Central Asian countries as well.

[Figure 6-4] Electricity Demand Forecast in Central Asia until 2029



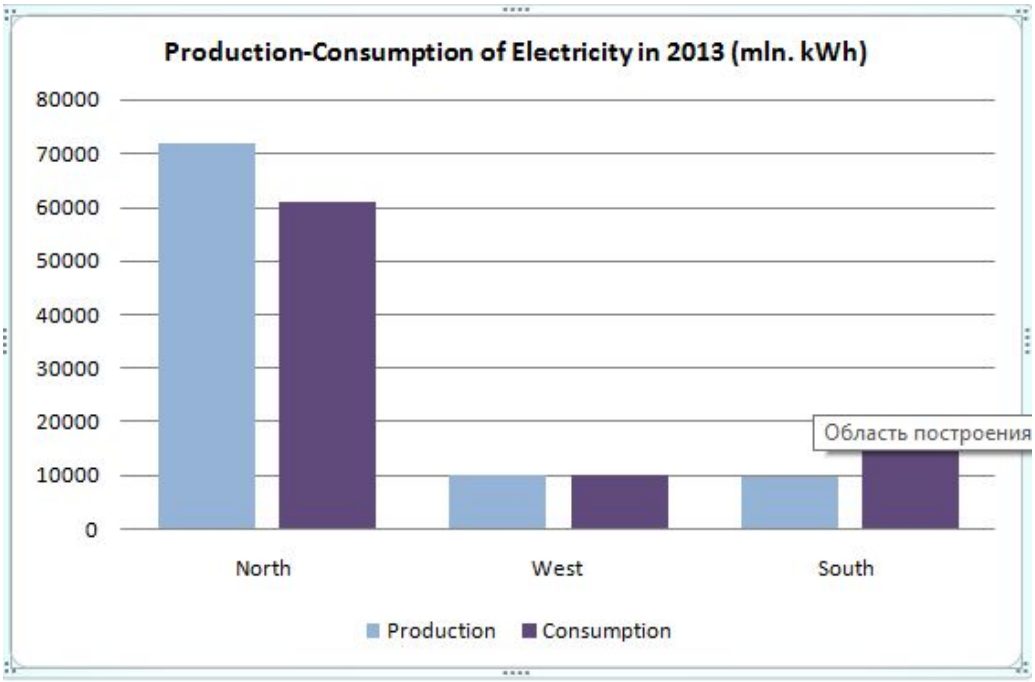
(Source: World Bank, 2010)

b) High energy demand in the domestic and foreign markets of neighboring countries;

More than 78% of the electricity has been producing near northern coal fields; more than 66% is used in the same industrial region. At the same time, consumption in the southern zone in 2013 exceeded production by almost two times (8.708 TWh)[14].

[14] http://www.kegoc.kz/en/

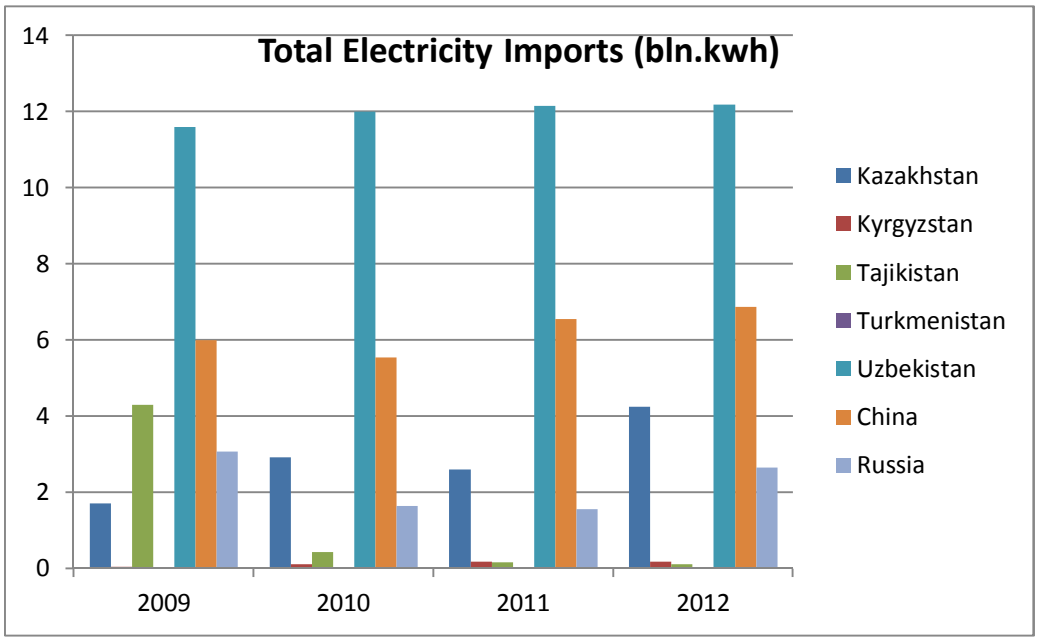
[Figure 6-5] Production-Consumption of Electricity in 2013 in Kazakhstan



(Source: Kazakhstan Electricity Grid Operating Company KEGOC)

Potentially, clean energy could be provided not only to the Kazakhstan's domestic market but also be exported to neighboring countries (see Figure 6-6).

[Figure 6-6] Total Electricity Imports in Central Asia



(Source:IEA)

In 2013, electricity exports from Kazakhstan to Russia have increased almost twice - from 1.98 TWh in 2012 to 3.75 TWh. Imports in Kazakhstan, on the other hand, fell from 2.55 TWh up to 1.6 TWh. It is assumed the possibility of exporting electricity from Kazakhstan to Belarus [Pavlodar Energo, 2013]

Moreover, according to the Shanghai Cooperation Organization, China has expressed interest in importing about 40 billion kilowatt-hours of electricity per year.

The stability of electricity supply is one of the vital problems of development not only for Kazakhstan, but also its closest neighbors.

c) *Diversification of export potential;*

Clean energy could be exported to neighboring and other countries.

d) *Legislation/policies to stimulate demand for clean energy;*

In recent years, the Kazakhstan Government has made significant moves to increase the level of national demand for renewable energy. It has imposed high environmental standards (e.g. binding commitments to reduce greenhouse gas emissions under the Kyoto Protocol), specific targets for renewable generation.

Investment preferences

In accordance with the Law on Investment dated 8 January 2003, № 373[15], the investment preferences granted under the investment contract signed with the Ministry of Investment and Development.

Investors can get the following preferences:

[15] http://adilet.zan.kz/eng/docs/Z030000373_

- Exemption from customs duties;
- State grants. Investors may be provided by the Government following kind grants: land, buildings, machinery and equipment, computers, measuring and control instruments and devices, vehicles (except passenger cars), industrial implements;
- Exemption from corporate income tax (20 %) for up to 10 years;
- Exemption from land tax for up to 10 years;
- Exemption from property tax for up to 8 years from the date when fixed assets (e.g., a plant) are commissioned (only for those assets which were commissioned for the first time);
- Reimbursement of up to 30 percent of actual expenses on construction works and purchase of equipment (so-called "investment subsidy") on the basis of documentary evidence after full commissioning;
- Guaranteed purchase of "green" energy state at rates approved by the regulator of the business plan;
- Free transportation of electricity to the end user.

Fixed Feed in Tariff & Product Purchasing Agreement

Fixed tariff for wind energy is 11 eurocent per kWh, solar energy – 17 eurocent per kWh, biomass 16 eurocent per kWh, small hydro – 8 eurocent per kWh combined with 15 years PPA.

e) *Strict environmental commitments setting to increase sophistication of demand;*

Kazakhstan is the first country in Asia to have implemented an economy-wide emissions trading scheme. The Kazakhstan's emissions trading scheme started on 1 January 2013 and covers 55% of the country's total greenhouse gas emissions. It currently includes 166 companies from the following sectors: power and heat production, coal mining, oil and gas extraction, chemical industry, metallurgy, cement industry and other process industries. The 178 companies participating to the first phase of the scheme emitted in 2010 a total of 147 million tCO2. The overall objective is a 15% emissions reduction below 1992 levels by 2020[16].

f) Sales market of quotas on emissions of CO2;

[16] https://carbonmarketdata.com/en/products/world-ets-database/kazakhstan-ghg-co2-emissions-trading

According to international consulting firm Point Carbon, the main sellers of quotas are currently the countries of Eastern Europe (the Czech Republic – 33%; Estonia - 15%; Poland – 7%). Major buyers of quotas are Japanese public and private companies, with 61% world trade, Spain with 14 %, and then American and Western European private companies.

Kazakhstan has great potential for participation in carbon trading. The country ratified the Kyoto Protocol in 2007 and is a relying party of application A, which gives it the right to participate in joint projects and the mechanisms of clean development. At the same time, Kazakhstan adopted voluntary commitments to reduce emissions by 15 percent in 2020 from the level of 1990[17].

g) *The transition from traditional energy sources to RES*

The transition to green economy will reduce Kazakhstan's dependence on mineral resources. Moreover, it is estimated that the transition into the green economy will be further increased by 3% of GDP, more than 500 thousand

[17] http://astanatimes.com/2014/03/carbon-tradings-benefits-green-economy/

new jobs, new industries and services to provide universally high standards of quality of life for the population will be created[18].

Weaknesses:

a) *Very low level of public awareness and managers regarding the possibilities of using renewable energy sources.*

Due to the fact that Kazakhstan for long time have been using traditional energy resources, public is poorly aware about the benefits of renewable energy.

b) *Legislation/policies/targets behind the leading countries*

The leading countries have had their policies in place more than 15 years before Kazakhstan, which has allowed renewable energy clusters, for instance, in Germany and the US to gain critical mass.

c) *Distance between major population centers dampens demand for large green projects*

[18] https://strategy2050.kz/en/news/1211

d) *Absence of a special state body and large business entities responsible for the development of RES*

There is no special government body which is responsible for the development of RES

e) *High cost of Renewable Energy*

The cost of production of alternative energy is several times higher than the cost of traditional energy production. For example, fixed tariff for wind energy is 11 eurocent per kWh, solar energy – 17 eurocent per kWh, biomass 16 eurocent per kWh, small hydro – 8 eurocent per kWh. Electricity tariffs from coal are close to the cost of its generation, excluding depreciation needed to replace aging equipment. Electricity tariff is around 3 cents/kWh.

6.4 Related and Supporting Industries

Strengths:

a) *Competitive Electricity Market*

Centralized trade markets ensure open non-discriminatory access of all participants to the electricity market and generate fair index of the current market electricity price. KOREM JSC (Kazakhstan Operator of Electric Power and Electric Energy) as an Operator of the Centralized Trade Market is responsible for operation of the centralized trade market (Order No. 54 dated 04 March 2004 of the Ministry of Energy and Mineral Resources).[19]

b) Agricultural sector creates synergies with biofuels

Kazakhstan's highly competitive production of grain, cereals, oilseed and sugar cane can help support the development of a biofuels.

c) The availability of production facilities and materials for the manufacture, installation and construction;

At present Kazakhstan has its own photovoltaic module production facilities

[19] http://www.kegoc.kz/en/power-industry/kazakhstan-electric-power-industry-key-factors/

using 100% Kazakh produced silicon (Kazakhstan's silicon reserves are equal to 250 million Tons), production of "solar" purity silicon ingots, ingot saw-cutting into blocks, block saw-cutting into plates, production of photovoltaic plates;

d) *Stimulating research and innovation to create a low-cost and high-performance technology*

Technology import and export of capital for learning the international experience in their respective industries abroad, on the one hand, reduce inflationary pressures in the country, on the other hand, will provide for Kazakhstan in the long-term stable income, according to estimates - more than 12 billion US dollars a year[Strategy, 2008].

Weaknesses:

a) *Weak manufacturing sector*

Investments in the fixed assets in the mining industry represent 30% of the total volume, and in the manufacturing industry only 12%. In the process of industrialization, the focus in the industry is gradually shifting towards the manufacturing industry, although its level of development remains relatively

low. Manufacturing sector generates less than 7% of employment and 11% of GVA in the country's economy [KazCham, 2014]

b) *Lack of transmission and distribution lines with minimal losses*

Losses of electricity in the main electrical network are slightly higher than in developed countries, which are characterized by a smaller distance power transmission and high capacity market. In addition, for the Republic of Kazakhstan is characterized by sharply continental climate, which adversely affects the losses in electric networks. In general, the loss of electricity in 2011 was estimated at 13.78%[20].

6.5 Strategy and Rivalry

Strengths:

a) Global Competitiveness Index- 42st

b) Member of WTO (from 2016)

c) Competition Law

[20] http://www.kazenergy.kz/arhiv/41/10.htm

The Law on Competition dated 25th of December, 2008 adjusts cartel agreements, unfair competition, and uncompetitive actions by state agencies.

d) *Wholesale Competitive Electricity Market with guaranteed purchase of electricity and FIT*

Weaknesses:

a) Lack of competition

State-owned companies generally have better access to natural resources, markets, credit, and licenses than private entities [USDS, 2015].

b) Weak IPR protection

Inadequate intellectual property rights protection in Kazakhstan is a key obstacle to attracting foreign direct investment to the Kazakhstan [Zhunisbekova, 1999].

Thus, rich natural endowments, strong legal and political institutions and a highly educated population are the foundation for Kazakhstan's tremendous

economic and social prosperity. However, challenges lie in the path of that prosperity continuing. Kazakhstan's future performance is constrained by a dependence on natural resources, a weak manufacturing sector and lack of specialists.

The analysis of Michael Porter's factors indicates the possibility of creating in Kazakhstan world class Renewable Energy industry, integrating all production stages from design, research and experimental work to manufacturing, construction and operation of electricity generation capacity from renewable energy sources.

Chapter 7 SWOT and TOWS Analysis of Central Asian Cooperation on Renewable Energy

7.1 Comparative Analysis on Renewable Energy Industries within Central Asian Countries

Renewable energy development in the countries of Central Asia is largely determined by their role in the power system of the former USSR and objects built before its collapse. So, thanks to existing cascade of hydroelectric stations on mountain rivers in Tajikistan, Uzbekistan and Kyrgyzstan that was built in the former Soviet Union, the share of renewable energy is high (more than half, and about a third of the energy balance in those countries). At that time, both in Kazakhstan and Turkmenistan is rich in traditional energy resources, the use of renewable energy is virtually low.

According to experts, the potential for renewable energy sources of Central Asian countries is significant and requires its use.

[Figure 7-1] Renewable energy in Central Asian electricity generation: technical potential and installed capacity

	Kazakhstan	Uzbekistan	Kyrgyzstan	Tajikistan	Turkmenistan
RE share in electricity generation, 2012	0.6%	3.2%	1.1%	2.5%	0,2%
Solar PV installed capacity, MW	<1	<1	0	<1	0
Solar PV technical potential, MW	3,760,000	593,000	267,000	195,000	655,000
Wind installed capacity, MW	2	< 1	0	0	0
Wind technical capacity, MW	354,000	1,600	1,500	2,000	10,000
Small hydro installed capacity, MW	115	394	41.4	132	5
Small hydro technical capacity, MW	4,800	1,800	1,800	23,000	1,300
Biomass installed capacity, MW	0	1.5	0	0	0
Biomass technical potential, MW	300	800	200	300	Not significant

(Source: UNDP renewable energy snapshots, 2014)

Currently, most of Central Asian countries developed and adopted state programs that set targets for the implementation of renewable energy. However, the development of renewable energy is carried out at different speeds and in different directions, depending on the climatic and economic conditions of these countries.

The analysis showed that the main motivations of renewable energy in Central Asia are [Kuzmich, 2013]:

- The pursuit of energy security

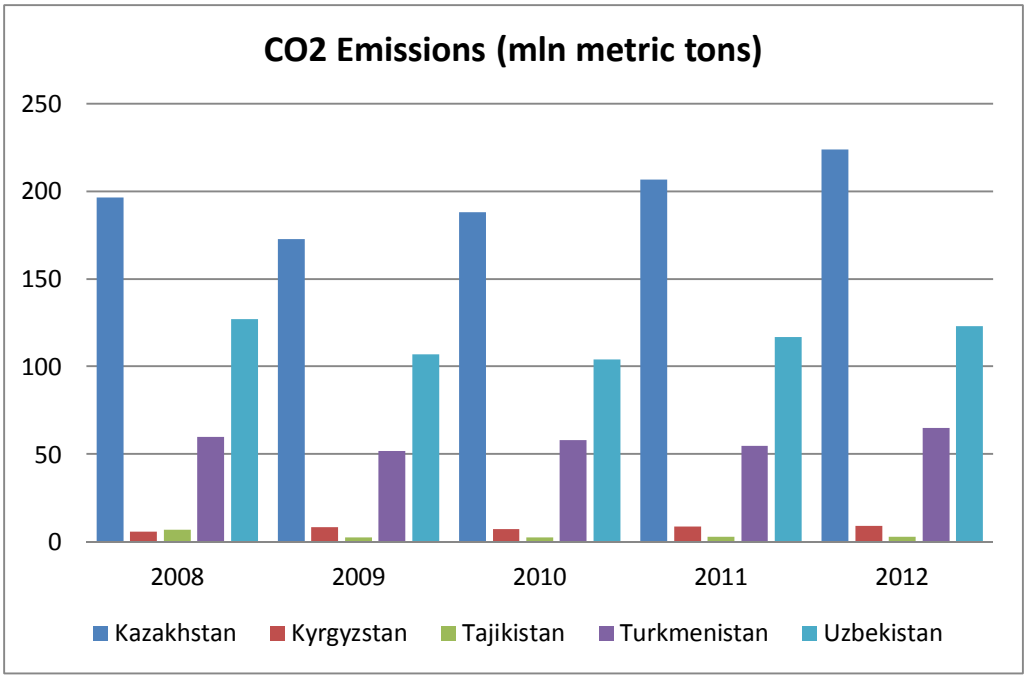
  The absence of supply diversification and the reliance on one energy source for electricity production makes the countries in the region highly vulnerable to fuel shortages and adverse climatic conditions (affecting hydropower). Central

Asian countries each use only one specific fuel source to produce more than 50% of their energy [UNDP, 2014].

- Flexibility of national energy systems in order to participate in regional electricity markets.
- The possibility of energy supply in remote areas where there is no electricity infrastructure.

  Production of renewable energy in Central Asia is especially important for remote areas where there is no electrical network. Increased use of renewable energy sources will have a positive impact on quality of life, employment; will contribute to the growth of economy, science and technology of Central Asia.
- Reducing greenhouse gas emissions in accordance with the country's obligations and / or recommendations of relevant international institutions.

[Figure 7-2] CO2 Emissions in Central Asian Countries



(Source: World Bank)

Kazakhstan has the most consistent climate policy among the Central Asian countries and announced the adoption of voluntary commitments to reduce greenhouse gas emissions by 15% by 2020 and by 25% by 2050 relative to 1990 levels and made a request for the inclusion of the country in Annex B to the Kyoto protocol, which was enshrined in the relevant Annex to the Copenhagen Accord.

Other countries in the region are also trying to take into account the issues of combating climate change in the implementation of state policy in the field of

renewable energy but didn't adopt any commitments to reduce greenhouse gas emissions.

All countries, with the exception of Turkmenistan, have strategic documents outlining their priorities in at least one renewable energy technology. Part of this effort is the adoption of targets and regulatory policies for renewables deployment. Two countries – Turkmenistan and Uzbekistan – have poorly developed regulatory policies for renewable energy [REN 21, 2015].

The most common support for renewable power generation is feed-in tariffs, which are used in Kazakhstan and Kyrgyzstan; exceptions are Turkmenistan; Tajikistan, Uzbekistan are using specific project feed- in tariff (Annex 1 and Figure 6-9).

[Figure 7-3] RE Policy Instruments in Central Asia

Country	POLICY DEVELOPMENT									
	Financial Incentives			Public Financing	Regulatory Policies					
	Capital subsidy, grant or rebate	Investment preferences	Tax incentives for RE	Public investment, loans and financing	FIT	RPS	Tradable RE	Grid access	RE and CO2 reduction targets	Law in RE
Kazakhstan	✓	✓	✓	Δ	o		✓	o	✓	o
Kyrgyzstan	✓	×	✓	Δ	Δ				×	Δ
Tajikistan		×	✓	Δ	Δ			o	✓×	Δ
Turkmenistan		×	×		×				×	Δ
Uzbekistan		×	✓	Δ	Δ			o	×	Δ

Δ - Policies require the improvement
o - Advanced policies

High fossil fuel subsidies and low electricity prices significantly lower competitiveness of renewable energy in Central Asia. In 2013, Uzbekistan – 58, 7%, Turkmenistan – 65,7% and Kazakhstan - 32,8% had the highest energy subsidy rates in Europe and the CIS (IEA, 2014).

Moreover, potential investors in renewable energy in the region have limited access to affordable bank loans and as a result, often cannot afford high initial investment costs [UNDP, 2014]. Another significant barrier is the lack of know-how and a limited number of local technology providers and specialists in the renewable

energy sector. Reliable feasibility studies and economic analyses on perspectives of renewable energy in Central Asian countries are either limited or lacking.

Today's slow pace of renewable energy development in Central Asia is largely determined by the following factors:

- The low competitiveness of renewable energy use projects compared with the projects on the basis of fossil fuel;
- The existence of institutional barriers related to the lack of regulations, encourage the use of renewable energy in the energy sector, the lack of long-term national strategy and an integrated program of support for large-scale use of renewable energy;
- The lack of infrastructure necessary for the successful development of renewable energy, including the lack of standards and quality of scientific maintenance of its development and financial support, lack of adequate information, including information on potential resources of renewable energy, the lack of regulatory and technical documentation, software tools required for the design, construction and operation of power generating

facilities, inadequate staffing, lack of mechanisms for the use of public resources to support the development of renewable energy [Kuzmich, 2013].

On the positive side, all Central Asian countries with the exception of Turkmenistan have adopted primary legislation on renewable energy as well as formally introduced a number of incentives such as grid-access, tax exemptions and feed-in tariffs [UNDP, 2014].

7.2 SWOT and TOWS Analysis of Central Asian Cooperation on Renewable Energy

For the concentration of financial, scientific and human resources for the development and production of renewable energy there is need for international cooperation.

This chapter examines the international cooperation of the countries of Central Asia in the field of renewable energy, considers the prospects of international cooperation in this field.

7.2.1 SWOT analysis

The assessment of the advantages and disadvantages of Central Asian (CA) cooperation in renewable energy development can be done using a SWOT analysis. This method helps to demonstrate how isolated or joint work will help to achieve the best optimization of the use of renewable energy.

SWOT-analysis demonstrates the significant advantages of CA cooperation, one of which is to improve the reliability of power. Cooperation in the region can provide a number of benefits to all participants, which suppress all possible defects. SWOT-analysis demonstrates the advantages and disadvantages of cooperation, reflecting also the external conditions that will help or hinder the creation of regional renewable energy system.

<Table 7-1> SWOT analysis

Strengths	Weaknesses
1. Huge and diverse potential of renewable energy 2. The use of advanced regional network 3. Existing legal base	1. Poor development of RE regulatory frame work in other CA countries 2. The potential risk of emergency situations in neighboring countries (which is offset b

4. Reduction of investment needs	y the ability to support by other neighbor ing countries) 3. Water Issue 4. The vulnerability of joint work legislation
Threats	**Opportunities**
1. The issue of national energy security as a result of possible dependence on ext ernal factors 2. The potential risk of a violation of agreements 3. Termination of power, resulting in socia l problems and economic losses	1. Energy security 2. Export the electricity outside the region 3. Development of projects of joint use of re newable energy 4. The development of scientific and technica l base, qualified personnel.

Strengths:

1. *Huge and diverse potential of renewable energy*

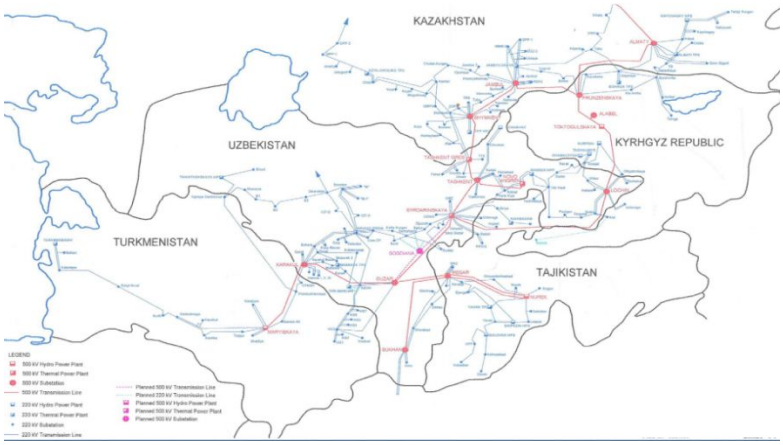
Wind energy: in all CA countries there is a great potential for the development of wind energy. Meanwhile, CA countries are the most interested in the development of solar energy where the number of sunny days in a year is the most among CIS countries. Hydro energy: hydro energy development is the most

important priority in the sphere of renewable energy sources development in most CA countries having significant water resources.

2. The use of regional network

The Grid Uzbekistan, South Kazakhstan, Kyrgyz Republic, Tajikistan and Turkmenistan formed Central Asian Power System (CAPS). The system was designed in the 1970s on the basis of uniform criteria for the planning system at the lowest cost. After the Soviet Union collapse, the countries of the CAPS continue to work in parallel on the basis of the "Agreement on the parallel operation", signed by the member countries in 1998. Based on this agreement, countries have identified a technique of frequency and power flows, the required reserve for each section of the regional power system and other important questions. Open access and free trade between power grids in the region are also important components of the parallel operation.

[Figure 7-4] Map of CAPS



3. *Existing legal base*

Basic documents governing the operation of the energy system in the region:

- Agreement on the coordination of intergovernmental relations in the energy sector of the CIS (1992), signed by all members of the CAPS. The purpose of this agreement is to establish a framework of effective operation of the regional power system;
- The agreement on the parallel operation of CIS member states (1998), signed by all the CIS countries;

- The agreement on the transit of electricity in the CIS (2000), signed by all the countries of the CAPS, except Turkmenistan and Uzbekistan;
- Agreement on mutual assistance in case of accidents and other emergencies at electric power facilities of States Parties (2002), signed by all the countries except Turkmenistan. In accordance with this document, in the event of disruptions in the system, contractors are obliged to provide electricity supply to the injured party. This electricity can be paid or refunded, depending on the specific agreements between countries.

4. *Reduction of investment needs*

Reduction investment needs due to developed regional network. It is also possible to optimize new investments in the sector thanks to the cooperation of countries and more efficient use of existing generating capacity in some countries of the region.

Weaknesses:

1. *Poor development of RE regulatory Framework in other CA countries*

As shown in Table 7-3 RE Policy Instruments in Central Asia, Kazakhstan

has more advanced legislation on development of renewable energy than in other CA countries.

2. *The potential risk of emergency situations in neighboring countries*

   In case if emergency situation happens in neighboring countries, it can impact on economic situation and security in Kazakhstan.

3. *Water Issue*

Each country has different interests concerning the use of water resources of shared rivers: for some it is the only source of electricity, for others the water is needed for irrigation purposes.

4. *The vulnerability of joint work legislation*

All countries except Uzbekistan have been approved the procedure of p ayment for transit services.

Opportunities:

1. *Export the electricity outside the region*

Afghanistan, Pakistan, Iran, China and Russia are all potential markets for electricity produced in Central Asia. **Afghanistan** currently experiences severe power

shortages. It has a small supply base and it lacks resources to build new capacity. Imports represent a near term option to meet its demand requirements. **Pakistan** is projected to face power supply shortages. Imports may well represent the least cost option to meet future demand. **Iran** experiences supply shortages during the summer. It purchases some electricity from Turkmenistan but could also have an interest in supplies from other Central Asian countries. **China** is experiencing a severe power shortage currently and Central Asian electricity has the potential to be an inexpensive import option to meet demand in the Urumqi area of the Xingjian province. **Russia** has an interest in balancing its system at the border with Central Asia (i.e. the border with Kazakhstan). It also views Central Asia as a potential source of inexpensive electricity supply that could support its ambitions to expand electricity exports to Europe [World Bank, 2004].

2. *Energy Security*

Improving the reliability of energy supply in the region as a whole and in each of the Central Asian countries in particular, because the country will not depend solely on its own generating capacity, and will also be able to rely on the capacity of neighboring countries.

3. *Development of projects of joint use of RE*

The development of joint projects will attract more investments and opportunities to region.

4. *The development of scientific and technical base, specialists*

The cooperation in development of scientific and technical base, in exchange of know-how and experiences, training of specialists will lead to development of renewable energy in Kazakhstan and in the region as well.

Threats:

1. *The potential risk of a violation of agreements*

Regional leaders seem disinclined to cooperate on any of their main problems. Suspicion is growing between the most directly affected countries, Kyrgyzstan, Tajikistan and Uzbekistan. The source of the problem is the disintegration of the resource-sharing system the Soviet Union imposed on the region until its collapse in 1991 [ICG, 2014].

2. *Termination of power from neighboring countries, resulting in social pro blems and economic losses*

The possible termination of electricity supply would lead to negative social consequences and economic losses.

3. *Energy security vulnerability*

The issue of national energy security as a result of possible dependence on external factors of other countries.

7.2.2 TOWS Analysis

<Table 7-2> TOWS analysis

TOWS Matrix		
	Opportunities	**Threats**
	Energy security	The issue of National energy security as a result of dependence on external factors
	Export of Electricity outside the region	Termination of power supply from neighboring countries
	Development of projects of joint use of RE	The potential risk of violation of

	The development of scientific and technical base, specialists	agreements
Strengths	**S-O Strategies**	**S-T Strategies**
Huge and diverse potential of RE	Development and implementation of joint projects;	Improve the mechanism of cooperation and coordination of the countries of Central Asia (the development of financial, economic, regulatory and legal mechanisms of CA cooperation in the field of renewable energy)
Existing legal base	Development and implementation of research programs (development of scientific and technical base and conduct joint research in the use of renewable energy, joint training and advanced training in the use of renewable energy sources)	
The use of advanced regional network	Information exchange and building a knowledge base (development of a common information space in the use of renewable energy, study and dissemination of international experience and expertise of CA's development of renewable energy	
Reduction of investment needs	Cooperation with the CIS and Asian countries	
	Creation and development in the CA countries favorable economic conditions for the joint implementation of projects for efficient use of renewable energy	

	Strengthening of relations with international financial institutions in order to develop schemes of financial support for projects and attracting investment for projects	
Weaknesses	**W-O Strategies**	**W-T Strategies**
The potential risk of emergency situations in neighboring countries	Harmonization of national programs and laws for the development of renewable energy	Coordination of enforcement mechanisms, and establish responsibility and monitoring the implementation of joint projects and activities
Weak development of RE regulatory framework in other CA countries	The establishment of mechanisms and procedures to ensure prompt and effective adjudication	
Water Issue		
	Environmental and energy sources safety and reliability of electricity and fuel supply to consumers	

Chapter 8 Conclusion and Policy Implications

Up to now, this study has analyzed competitiveness of renewable energy industry of Kazakhstan. Moreover, the SWOT analysis was applied to examine strengths, weaknesses, opportunities, and threats of Central Asian cooperation in renewable energy field in the context of advancing Kazakhstan's renewable energy policies and technologies and expanding domestic renewable energy installations through this cooperation. Based on SWOT analysis, the strategies were developed using the TOWS Matrix. This chapter will summarize what has been discussed with a list of key findings and concludes with a couple of policy recommendations for promotion and development of renewable energy in Kazakhstan.

8.1 Key Findings

This research has applied several approaches to discuss strengths and flaws of renewable energy industry of Kazakhstan and identify a capacity for additional renewable energy deployment in Kazakhstan.

Firstly, the analysis of Michael Porter's factors indicated the possibility of creating in Kazakhstan competitive Renewable Energy industry, integrating all

production stages from design, research and experimental work to manufacturing, construction and operation of electricity generation capacity from renewable energy sources. Kazakhstan has a huge potential of renewable energy sources. In order to save fuel and energy resources, reduce the negative impact on the environment and the implementation of commitments under the Kyoto Protocol, as well as providing power to regions with weak electrical connection to the UPS of Kazakhstan, requires the development of renewable energy. The prospects of creating a world-class renewable energy in Kazakhstan are originally a much more promising precisely because of exceptionally favorable natural factors, primarily because of the large territory, good potential for renewable energy development and supporting policies.

Secondly, the greatest benefit from the development of renewable energy will be obtained through deliberate policy that encourages the use of renewable resources through the development of relevant industries, research, educational programs, support for investments, creation of favorable customs and tax regimes, international cooperation and other measures.

Thirdly, it is important to develop and apply technological innovations that would allow not only to achieve the best competitive advantages using existing

synergies through natural, industrial, geographical features, which will determine the technological structure of renewable energy, its cost and marketing advantages.

Finally, the use of existing interconnections between different areas of the Central Asian region is the most low-cost solution for reliable power supply to consumers in the region. The cooperation contributes to the development of renewable energy, providing the ability to export the excess of electricity to the region and beyond, the possibility of implementing projects of regional scope those are too large for a single country, the exchanging the knowledge, know-how and experiences. In other words, the cooperation in the region provides additional incentives for investment in electricity production from renewable sources. Realizing the importance of the cooperation between renewable energy industries within Central Asian countries, the government of Kazakhstan has to interact in cooperation and exchange of experience between Central Asian countries to strengthen domestic and regional renewable energy sectors and compete in the global renewable energy market.

8.2 Policy Implications

Rich natural endowments, strong legal and political institutions and a highly educated population are the foundation for Kazakhstan's tremendous economic and social prosperity. However, challenges lie in the path of that prosperity continuing. Kazakhstan's future performance is constrained by a dependence on natural resources, a weak manufacturing sector and lack of specialists. All of them may impose negative impacts on the sustainable development and renewable industry of Kazakhstan.

In order to successfully create a green industry, Kazakhstan should develop a strategy for the renewable energy further development with which would be possible to achieve competitive advantage, allowing creating long-term benefits and added value for all stakeholders and society as a whole.

The strategy of renewable energy development should be based on the positional analysis of the potential of renewable energy of Kazakhstan, which would be aimed at overcoming the weaknesses to meet the opportunities and strengths.

Firstly, to help to overcome the existing problems in development of renewable energy in Kazakhstan, it should actively pursue closer linkages with neighboring

countries. Given a certain similarity of Central Asia in terms of climatic conditions, economic structures, a common border, should be encouraged to cooperate and exchange knowledge and practices in the field of energy efficiency and renewable energy. The basis for such cooperation should be:

- Cooperation in order to build a closed chains of the production and use of renewable resources in the region;
- Insurance of energy security of Central Asian region;
- Development of scientific and educational potential of countries, exchange of know-how.

Secondly, government should phase out subsidies fossil fuel technologies to promote competition between fossil fuel and renewables.

Thirdly, Kazakhstan government should increase the financial resources available for commercialization and deployment of renewable energy in Kazakhstan. The government should increase public sector R&D spending and provide incentives for private sector contribution. Moreover, government should establish of incubators to commercialize the scientific ideas with collaboration of

universities and small and medium enterprises.

Fourthly, Kazakhstan should enhance and support the competitiveness of the manufacturing sector using best practices and new technologies to promote manufacturing abroad.

Finally, Kazakhstan should roll out a national educational and accreditation system for vocational training in the renewable energy sector. The universities should place a special emphasis on developing programs in continuing education to ensure that the staffs are up to date on latest developments in renewable energy technology.

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Law on Competition of Republic of Kazakhstan dated 25 December 2008.

Appendix

#	Indicator	Kazakhstan (RK)	Kyrgyzstan	Tajikistan (RT)	Turkmenistan	Uzbekistan
1	A legal framework that encourages the use of renewable energy	Law of RK 25.12.1997 № 210-I «On Energy Saving" Law of the RK 4.07. 2009 "Support for the use of renewable energy" Regulations:	Law of the Kyrgyz Republic "On Energy Saving" of 06.07.1998 Law of the Kyrgyz Republic "On renewable energy sources" 08. 2008	RT Law "On Energy". RT Law "On Energy Saving" Presidential Decree "On additional measures for energy conservation",	Outlined the development of national laws on energy conservation and legal acts in the area of energy conservation and efficiency	Law of the Republic of Uzbekistan "On the rational use of energy." Law "On Electric Power Industry", 30.09.2009 №225.

		- Rules on monitoring the use of renewable energy, approved by the Decree of the Government of the RK on October 5, 2009 №1529. - Terms of the purchase of electricity from qualified energy producing organizations, approved by order	Law "On Amendments and Addenda to the Law" On renewable energy sources "3.08. 2012 (improvement of promoting the use of renewable energy sources)	2009 The law on the use of renewable energy sources, 2010		Decree of the President of Uzbekistan "On measures for further development of alternative energy sources" 01/03/2013 The law "On Alternative Energy Sources"

		of Minister from 29.09.2009 №264. - The rules for determining the nearest point of connection facilities for the use of renewable energy, approved by order of the Minister of 1.09.2009 g.№270. - Terms of agreement and				

		approval of the feasibility studies and construction projects on the use of renewable energy, approved by the Decree of the Government of the RK on 25.12.2009 year №2190. Project of the Government of the RK and the UN Development Program,				

		Kazakhstan - Wind Power Market Development Initiative.				
2	Availability of public policies and action plans	In accordance with the Strategic Development Plan of RK until 2020, the share of the alternative energy sources in the total energy consumption should reach 1.5% by 2015 and	The program of development of small and average power in the Kyrgyz Republic until 2012 (a Directorate of the project on the development of small and medium power in	Energy policy is formed on the basis of the National Development Strategy of the Republic of Tajikistan for the period up to 2015 NDS is based on the following	The Energy Strategy until 2030 is under development In 2012-2013, the country has developed a "National Strategy of Turkmenistan on climate	The program of the development of alternative energy sources for 2013-2017. Hydropower development program, providing the construction of 15 new small

		more than 3% - by 2020. The state program for accelerated industrial-innovative development of Kazakhstan for 2010 - 2014 years, including the use of renewable energy resources. The comprehensive plan to improve	Kyrgyzstan 14.10. 2008 № 365 National Energy Program of the Kyrgyz Republic for 2008-2010. The development strategy of fuel and energy complex till 2025, approved by the Governmental Decree dated 13.02.2008 of №47	principles: - energy security, - energy efficiency of the economy, the budget energy efficiency, environmentally sound energy. The program for the efficient use of hydropower resources and energy saving in 2012-2016 g №551 The program of	change", according to which in the future will be created "Action Plan" containing measures to combat climate change, including development of the sphere of renewable energy	hydropower plants with total capacity of 420 MW (1.6 bln. KWh / year)

		energy efficiency in the Republic of Kazakhstan in 2012 - 2015 years. The development of the law on renewable energy sources - Layout of facilities for the use of renewable energy sources. The "Industry power development	The Government of the Kyrgyz Republic 28.06.2009, № 476 approved the Regulations on the procedure of construction, acceptance and grid connection of small hydropower stations to electric networks, which regulates the construction of	construction of small hydropower plants for 2009-2020 Develop strategies for renewable energy sources. The Tajik government decree №41 year 2.02.2007 approved the use of renewable energy program for 2007-2015		

		program for 2010-2014.". -Section Program development and use of renewable energy, attracting investments in this area.	technological connection to electric networks of small hydroelectric power plants, as well as the procedure for acceptance into operation completed construction of small hydropower plants.			
3	Feed-in tariff, stimulating the	Fixed tariff for wind energy is 11	The Law of the Kyrgyz Republic	The Government of Tajikistan		The Law on Rational Energy

	development of renewable energy sources	eurocent per kWh, solar energy – 17 eurocent per kWh, biomass 16 eurocent per kWh, small hydro – 8 eurocent per kWh combined with 15 years PPA	on Renewable Energy Sources created a legislative framework for renewable energy feed-in tariffs. The tariffs are designed to ensure reimbursement and coverage of investment costs for up to eight years	promotes renewable energy with project-specific feed-in tariffs. The tariffs are based on the project's costs and guaranteed for 15 years		Utilization introduces project-specific feed-in tariffs by allowing a sufficient return on the capital invested, the future operation costs and other technical costs for renewable energy facilities.

국문 초록

카자흐스탄은 태양열, 수력, 풍력 등 재생에너지의 국내 잠재량이 풍부함에도 불구하고 총 전력설비 용량 중 재생에너지의 점유율은 1%에 불과하다. 카자흐스탄에서는 기후변화에 대응 저탄소 그린에너지의 개발보급이 요구되는 가운데 재생에너지를 개발·보급하는 것이 중요한 정책과제로 등장하고 있다. 본 연구는 마이클 포터(Michael Porter)의 국가경쟁력 결정 (Determination of National Competitive Advantage) 이론을 활용, 카자흐스탄의 재생에너지 산업의 경쟁력을 분석하였다. 또한 주변 중앙아시아 국가들의 재생에너지 관련 정책과 산업경쟁력을 조사·분석함으로써 카자흐스탄의 상대적 국가 및 산업경쟁력 우위에 기초한 재생에너지 개발 및 보급 전략을 도출하고자 하였다. SWOT 분석은 강점(Strengths)과 약점(Weaknesses), 기회(Oppotunties)와 위협(Threats) 요인을 분석하고, 중앙 아시아 협력을 통해 국내 재생에너지 기술개발 및 정책방향을 수립하기 위해서 사용되었다.

마이클 포터의 경쟁력 요인 분석을 통해 카자흐스탄에서 세계적인

수준의 재생에너지 산업을 육성하는 가능성을 가늠하게 되었다. 그러나, 이러한 가능성이 현실화되기 위해서는 해결해야 할 여러 과제들이 남아 있다. 이러한 가운데 향후 성과는 천연자원에 대한 의존, 취약한 제조업 부문, 전문인력의 부족과 같은 요인들에 의해 제약을 받게 된다. 분석결과 여러 가지 제안들을 제시하였다. 즉, 1) 재생에너지와 화석연료 간의 경쟁을 용이하게 하는 정책의 수립; 2) 카자흐스탄의 재생 에너지 보급과 산업화 촉진을 위한 공공 및 민간 부문에서의 재정적인 지원 확대; 3) 재생 에너지 산업을 지원하기 위한 카자흐스탄 제조업 부문의 역량 강화; 4) 재생에너지 전문 인력 양성이다.

카자흐스탄과 기타 중앙 아시아 국가들 간의 재생에너지 협력에 대한 SWOT 분석은 재생 에너지 개발을 위한 국가들 간의 협력이 지닌 중요성에 대해 시사하는 바가 크다. 마지막으로 본 연구결과 의거, 재생에너지 개발 및 보급 확대를 기반으로 카자흐스탄의 경제 및 산업 발전 가능성을 모색할 뿐만 아니라, 더 나아가 중앙 아시아 지역의 재생에너지 부문의 역량을 강화하기 위해 카자흐스탄과 다른 중앙 아시아 국가들 간의 협력 확대가 필요하다는 공감대가 형성되기를 기대한다.