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RENEWABLE ENERGY SOURCES IN KAZAKHSTAN

"We still do not know one thousandth of one percent of what nature has revealed to us."
Albert Einstein (1879-1955)

Abstract

These days, around the world the electric power is one of the most valuable resources used in many needs of mankind. So, it is necessary to understand that the electrical power balance around the world has extremely precarious position. Within evolution of mankind, consumption of the electric power increases, and major factors of its production don't cope with such tension … In this article there are the main studied energy resources, which have the status of "inexhaustible". Also, methods of use of these energy resources in our domestic needs, and methods of implementation of the new projects connected with it. The author considers some evolutionary methods, programs and projects having potential in development of use of the processed energy resources.

Keywords: energy, ecology, development, technology, green economy.

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Қазақстандағы жаңғырмалы энергия көздері

Бұл күндері, бүкіл әлемде, көптеген қажеттікке пайдаланылатын адамзат ресурстарының бірі - бағалы электрэнергиясы болып табылады. Бұдан біз бүкіл әлемдегі электро-энергиялық теңгерімнің өте тұрақсыз жағдайда тұрғанын түсіне аламыз. Адамзаттың эволюциялық тұрғыда ұлғаюымен, электрэнергияның тұтыну көлемі артып жатыр, ал энергия өндірісінің негізгі факторлары тұтынушылырадың қалауларын толығымын қанағат-тандыра алмай жатыр. Бұл мақалада "шексіз" ретінде қабылданатын қайта өңделетін энергия ресурс-тары қарастырылады. Сонымен қатар, энергия ресурстарды біздің қажеттікке пайдалану әдістері мен тәсілде-рінің жаңа жобаларды қарастырылады. Бұл мақала авторлары, қайта өңделетін энергияның қолданудағы эволю-циялық әдістерін, түрлі бағдарламалар мен жобаларын қарастырып, талдайды.

Түйін сөздер: энергия, экология, даму, технология, жасыл экономика.

Аннотация

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Возобновляемые источники энергии в Казахстане

Сегодня во всем мире электроэнергия является одним из ценнейших ресурсов, используемые во многих нуждах человечества. Из этого, следует понимать, что электроэнергетический баланс во всем мире имеет крайне шаткое положение. В пределах эволюции человечества потребление электроэнергии увеличивается, а основные факторы ее производства не справляются с таким напряжением. В данной статье указаны основные перерабатываемые энергоресурсы, которые имеют статус "неиссякаемых". А также, способы использования этих энергоресурсов в нуждах нашего быта, и способы реализации новых проектов связанных с этим. Авторы рассматривают некоторые эволюционные методы, программы и проекты, имеющие потенциал в развитии использования перерабатываемых энергоресурсов.

Ключевые слова: энергия, экология, развитие, технология, зеленая экономика.

Renewable energy is energy produced from natural resources which are replenished such as wind, solar, biomass, geothermal and hydro power. Governments and companies around the world are investing heavily in developing technologies to harness the power of clean renewable energy sources because of their potential to produce large capacities of energy without generating greenhouse gases which can contribute to climate change.

Renewables have experienced a significant progression over the last period, both in developed and

developing countries. Nevertheless, they are far from reaching their full potential and still account for a minor part of the world's energy industry.

Raising the conversion to a low carbon society involves a substantial volume of investments in sustainable energy technologies (Meyer et al., 2009; OECD, 2008; Stern et al., 2006; UNFCCC, 2007). Nevertheless, mobilizing private capital in this field is particularly challenging in the current economic context, as investors seem to display a certain risk aversion. As pointed out by Saponar (2010), analysts perceive an underweight in the sector as a result of disappointment and structural concerns.

Kazakhstan has a lot of potential for the use of alternative or renewable energy sources, which in the long term should replace natural resources, as well as reduce costs for energy supply and transportation, and lead to overall improvement of environment. The President of the Republic of Kazakhstan strained that the country's transition to a «green» way of development is the strategic objective and proclaimed within the principles of «Kazakhstan Strategy - 2050: a new policy of the State».

One of the priority guidelines of development of «green economy» is the development of renewable energy sources. According to the Concept, the country shall target to achieve a 3% share of renewable energy in total electricity by 2020, which is an ambitious task taking into consideration that the current share of renewable energy use in Kazakhstan is less than 1% of the energy balance of the Republic of Kazakhstan. Therefore, in order to implement the ambitious plans, a number of regulations are being adopted to regulate the energy supply market when using renewable energy sources. Many of the existing legal acts contain significant deficiencies of legal, technical and conceptual nature, and do not take into account accumulated successful experience of foreign countries.

Though, some positive legislative changes should be distinguished, as the abolition of licensing requirements for production, transmission and circulation of electric and thermal energy, operation of power stations, electricity grids and substations, as well as the use of renewable energy. This research work will draw the attention of the state investment in the field of regulation of renewable energy in the Republic in Kazakhstan.

Current trends and prospects of the development of renewable energy sources in Kazakhstan

The last years were extraordinary ones for renewable energy, with the largest global capacity additions seen to date, although challenges remain, particularly beyond the power sector. The year saw several developments that all have a bearing on renewable energy, including a dramatic decline in global fossil fuel prices; a series of announcements regarding the lowest-ever prices for renewable power long-term contracts; a significant increase in attention to energy storage; and a historic climate agreement in Paris that brought together the global community.

Renewables are now recognized around the world as mainstream sources of energy. Rapid growth, particularly in the power sector, is driven by numerous factors, including the improving cost-competiveness of renewable technologies, devoted policy initiatives, better admittance to financing, energy security and environmental concerns, growing demand for energy in developing and emerging economies, and the essential for admission to contemporary energy. Consequently, new markets for both centralized and dispersed renewable energy are evolving in all regions.

One of the most notable features of renewable forms of energy is the diversity of technologies and resources. There is little doubt that the ultimate size of the renewable energy resource is large and could, in principle, make a very substantial contribution to world energy demands - easily exceeding current world electricity supply for example (**see Table 2**). An overview of the leading resources and the technologies for harnessing them is provided in **Table 1**.

Table 1 Global renewable energy resources

Resource	Scale of technical potential (TW h/year)	Energy conversion options
Direct solar	*12,000 - 40,000*	Photovoltaics, Solar thermal power generation, Solar water heaters
Wind	20,000 – 40,000	Large/small scale power generation, Water pumps
Wave	2000 – 4000	Numerous designs
Tidal	>3500	Barrage, Tidal stream
Geothermal	4000 – 40,000	Hot dry rock, hydrothermal, magma

Biomass	8000 – 25,000	Combustion, gasification, pyrolysis, digestion, heat and electricity

Source: UNDP/WEC (2014)

Table 2 Installed capacities and output of new renewables

	Capacity (MW)	**Approx. annual output[1] (TW h/year)**
Biomass (modern)	*35,000*	185
Wind	20,000	50
Geothermal	8200	44
Small hydro	3000	15
Solar PV	1200	1
Solar thermal	350	0.2
Total	**68,550**	**356**
	Capacity (GW)	**Output (TW h/year)**
Current world electricity	**3,000,000**	**15,000**

Source: UNDP/WEC (2014) and Wind Power Monthly (2013)

Renewables are capable to provide energy in several forms – heat, fuels, electricity – and at a range of scales. In electricity generation these varieties from large-scale grid-connected technologies to the provision of small volumes of power for isolated villages or telecommunications. Similarly, the occasions to use renewable fuels ranges from small niche markets to large scale blending with conventional fuels.

The method here is to focus on key technologies and their progress in leading markets rather than endeavoring to assess resources and technologies on a region by-region or application by-application basis. However, it is notable that scenarios of future energy supplies suggest that future energy systems will be characterized by more renewables and much greater diversity – both in terms of regional resource use and scale and type of technology application (Shell, 1995).

Wind power

We have been harnessing the wind's energy for hundreds of years. From old Holland to farms in the United States, windmills have been used for pumping water or grinding grain. Today, the windmill's modern equivalent – a wind turbine – can use the wind's energy to generate electricity.

Wind power is the conversion of wind energy by wind turbines into a useful form, such as electricity or mechanical energy. Large-scale wind farms are typically connected to the local power transmission network with small turbines used to provide electricity to isolated areas. Residential units are entering production and are capable of powering large appliances to entire houses depending on the size. Wind farms installed on agricultural land or grazing areas, have one of the lowest environmental impacts of all energy sources.

Wind power has the potential to produce 25 times more energy in a year than Kazakhstan’s current production from hydrocarbons. It is estimated that 10-15% of the land in Kazakhstan has average wind speeds of over 6 m/s making Kazakhstan prime for an increase in wind power. Wind power will play a large part of the 2020 goal to expand the renewable energy generating capacity to 1,040 megawatts from 110 megawatts last year.

One of Kazakhstan’s power companies, Samruk-Energy JSC, was recently awarded a $94 million loan from the Eurasian Development Bank to build Kazakhstan’s largest wind farm. The project will produce 172 million kilowatt/hours of electrical energy per year, save more than 60 million tons of coal, and reduce emissions of greenhouse gases [1].

Kazakhstan's steppe geography makes it suitable for wind energy applications and the estimated potential of wind energy that can be economically developed is about 760GW [2]. About 50% of Kazakhstan's territory has average wind speeds suitable for energy generation (4-6 m/s) with the strongest potential in the

Caspian Sea, central and northern regions. The most promising individual sites are in the Almaty region in the Djungar Gates, 600 km northeast of Almaty close to the Xinjiang border and the Chylyk Corridor 100 km east of Almaty. Wind potentials of 525Wm2 in the Djungar Gates and 240Wm2 in the Chylyk corridor have been estimated with power production from wind turbines potentially achieving 4400 kW/h/MW and 3200 kW/h/MW respectively [3].

Solar power

Photovoltaic (PV) Solar power is harnessing the suns energy to produce electricity. One of the fastest growing energy sources, new technologies are developing at a rapid pace. Solar cells are becoming more efficient, transportable and even flexible, allowing for easy installation. PV has mainly been used to power small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array. The 1973 oil crisis stimulated a rapid rise in the production of PV during the 1970s and early 1980s. Steadily falling oil prices during the early 1980s, however, led to a reduction in funding for photovoltaic R&D and a discontinuation of the tax credits associated with the Energy Tax Act of 1978. These factors moderated growth to approximately 15% per year from 1984 through 1996. Since the mid-1990s, leadership in the PV sector has shifted from the US to Japan and Germany. Between 1992 and 1994 Japan increased R&D funding, established net metering guidelines, and introduced a subsidy program to encourage the installation of residential PV systems. Solar installations in recent years have also largely begun to expand into residential areas, with governments offering incentive programs to make “green” energy a more economically viable option (Anderson, 1998).

The potential for profound innovation sits alongside continued improvements and scale economies in existing module types. Both will yield cost reductions. This makes the future for PV difficult to read. A direct comparison between engineering assessments and learning curves[4] found that the historical learning curve for PV provides less ambitious cost reduction projection than recent engineering assessments. Learning rates of up to 30% are not untypical in the semi-conductor industries.

The 18-20% historical learning rate of the last 15 years may prove conservative[5] and projecting costs on the basis of historic learning rate and market growth rate may understate the potential of PV. Nevertheless, the Energy Review team found that there would be very significant cost reductions over the period to 2025 if a 20% rate of learning is extended into the future, and if PV installations continue to grow at an average 25% p.a. This is illustrated in Figure 2, which also shows the assumed growth in installed capacity.

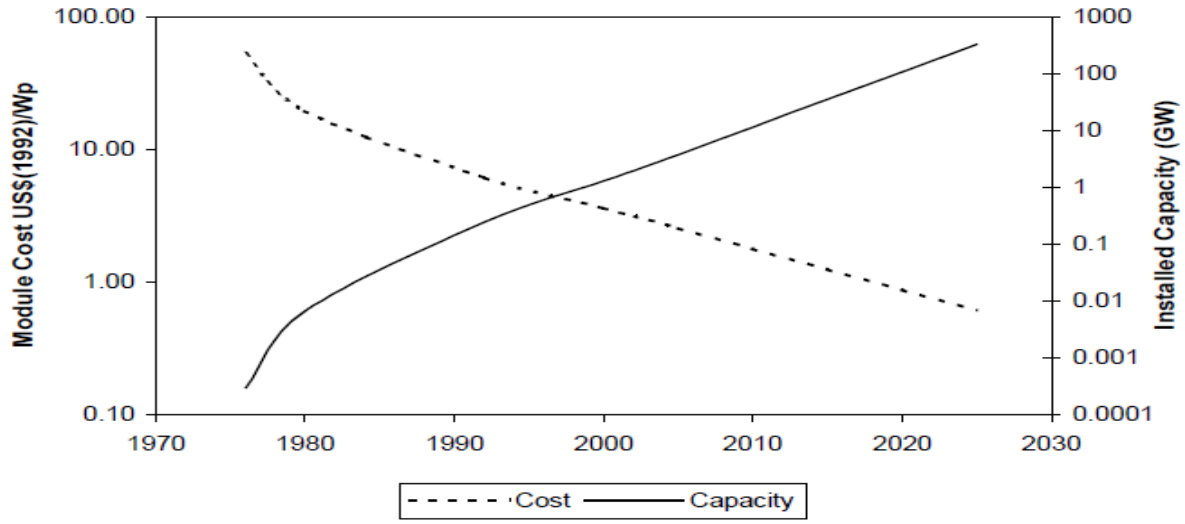

Figure 1 Illustrating the growth in capacity and reduction in costs for solar PV assuming a learning rate of 20% (PIU, 2001)

Kazakhstan has areas with high insolation that could be suitable for solar power, particularly in the south of the country, receiving between 2200 and 3000h of sunlight per year, which equals 1200-1700 kW/m2 annually [6]. Both concentrated solar thermal and solar photovoltaic (PV) have potential. There is a 2MW solar PV plant near Almaty and six solar PV plants are currently under construction in the Zhambyl province of southern Kazakhstan with a combined capacity of 300MW.