

Renewable energy technology uptake in Kazakhstan: Policy drivers and barriers in a transitional economy



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ABSTRACT

Kazakhstan has considerable renewable energy potential, the development of which can provide significant environmental, economic and social benefits. The country's national low carbon energy strategy aims to bring the share of renewables in electricity production to 50% by 2050. Despite the considerable renewable energy resource base, and ambitious deployment targets, the current contribution of non-hydro renewable energy to final electricity demand is less than one percent. Adoption of renewable energy technologies in a fossil fuel resource-rich country like Kazakhstan remains a big challenge but current low oil prices and a weakening economy may offer new opportunities. Deploying an Analytical Hierarchy Process methodology we identify the most significant barriers to uptake of renewable energy in the context of the electricity sector. The main factors preventing the penetration and scale-up of renewables include: a political and regulatory framework which supports and promotes a continued focus on fossil fuels, supported in part by regional geopolitics; a lack of awareness of sustainable alternative energy generation systems and a combination of social poverty and poor education in communities that are most likely to benefit from broadly distributed renewable technologies; market conditions driven by current electricity tariffs; inefficient but incumbent power technologies; and a high-risk business environment. Ranking barriers by importance will provide practitioners and regulators a mechanism to improve policies and incentivize renewable energy uptake in Kazakhstan and other resource-rich transition economies in Central Asia.

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1. Introduction

Over the last few decades, the global use of fossil fuel has grown more than twenty-fold [1] and is expected to increase further [2] due to the twin-pressures of economic development and population growth. The rapid rise in the demand for energy has seen global carbon emissions from fossil fuels increase more than 16 times between 1900 and 2010 [3] and has been linked to environmental degradation [4]. In this context, the development of renewable energy resources to meet the increasing demands of the electricity sector forms a major component of many national decarbonisation strategies [5]. In electricity markets in the dominantly high-income OECD nations, renewable energy technologies have become affordable to build and operate with the help of subsidy regimes and in some cases the scale of operation is approaching grid parity [6]. In developing country contexts, the ability to deploy renewable energies at relatively small scales has been cited as a key form of technology leapfrogging [7] with the potential for micro-grid rural electrification able to secure development benefits and energy access without the need to connect to national systems [8,9] and bring significant positive impacts on local environmental quality and public health [10]. However, the deployment of renewable energy technologies in transitional economies [11] which lie between mature electricity markets in OECD nations and developing country status remains a significant challenge [12]. This is particularly true in Central Asian post-socialist economies which display extremely high energy use per unit of GDP, acute developmental needs, and fossil fuel endowments large enough enable net energy exports [13]. In this context, while renewable energy has significant potential taken up is poor due to economic, institutional, technical and governance barriers, which are difficult to surmount without the drivers of reducing energy imports. In addition easy access to fossil fuels driving a low unit price of energy makes alternative options unattractive [14].

Previous research in Kazakhstan has examined the environmental pollution from energy sector (air and, water pollution, soil contamination and nuclear radiation [15]); electricity tariff policy [16]; macro-economic aspects of Kazakhstan's energy sector [17]; the energy efficiency potential in electricity and heating systems [18]; the energy saving potential in the residential sector [19]; and the current energy situation in Kazakhstan including fossil energy and renewable resources [20]. However there is little information on the Kazakhstan renewable energy market. Here we use both qualitative and quantitative methods to rank the likely barriers to renewable energy technologies by importance and frame this in the context recent oil price reductions on the Kazakhstan economy, and other geopolitical developments. Over the past two years, oil prices have declined from over 100 U.S. dollars per barrel to less than 35 U.S. dollars per barrel [21] which has slowed Kazakhstan's GDP growth from 2014. Growth fell from 6.0% in 2013 to an estimated 3.5% in 2014, and is projected to drop to 1.3% in 2015 [22]. The loss of consumer purchasing power and of consumer confidence after a strong devaluation of the national currency [23] has also affected the economy with weaker external demand for oil exports (from China and Russia) and lower oil prices have caused

Kazakhstan's current account and fiscal balances to deteriorate. Economic problems in Kazakhstan have also created some pessimism towards energy transitions. In a sustained low oil price environment, the future of renewable energy technologies in oil-exporting countries might be determined by number of barriers [24]. This article explores uses the analytical framework of Painuly [24] to identify the barriers to renewable energy adoption and then quantitatively ranks these barriers using Saaty's Analytical Hierarchy Process [25]; findings are contextualized and provide targets for planners and policymakers seeking to increase renewable energy penetration into a dominantly fossil fuel-based market.

2. Geographical, economical and energy status in Kazakhstan

Kazakhstan lies in the heart of Central Asia. It is bordered to the north by Russia, to the east by China and Mongolia, to the south by the Kyrgyzstan, Uzbekistan and Turkmenistan, and to the west by the Caspian Sea. The country comprises 14 provinces that are further divided into districts, sub-districts and villages. With an estimated 17 million people as of 2014 Kazakhstan is the 65th most populous country in the world, though its population density is among the lowest [26]. It is projected that the overall national population will reach 24.3 million by 2050 with annual average growth 0.6% per year (Fig. 1) [27]. Kazakhstan is a newly industrialized, upper-middle income country which is rich in fossil fuels; its reserves-to-production ratio is 40 years for oil, 35 years for gas and 150 years for coal [28]. The economy of Kazakhstan is export-dependent with exports accounting for 75% of GDP [29]. For a nominal GDP at market rates of approximately 224 billion US dollars, Kazakhstan is the 2nd largest economy among former Soviet Union countries, after Russia [29]. Real GDP grew by average 7% during 2004–2013 (Table 1) [30] and was projected to almost double by 2030 and increase by five times by 2050, with the GDP structure shifting to a larger share of the service sector (Fig. 2) [27]. However actual growth in Kazakhstan depends on the global economic situation, oil prices and fuel price stabilization [22]. Kazakhstan's economy is highly carbon intensive and economic development and population growth have necessitated an

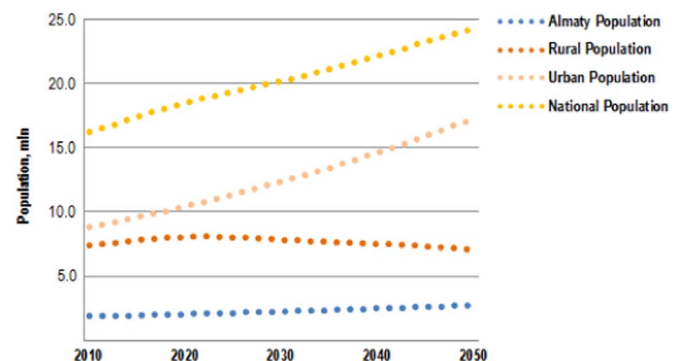


Fig. 1. Forecasted demographic trends in Kazakhstan [27].

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