



Contents lists available at ScienceDirect

## Renewable and Sustainable Energy Reviews

journal homepage: [www.elsevier.com/locate/rser](http://www.elsevier.com/locate/rser)

## An overview of Afghanistan's trends toward renewable and sustainable energies

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### ARTICLE INFO

#### Keywords:

Afghanistan  
Renewable energy  
Energy production  
Energy supply  
Challenges

### ABSTRACT

Relentless environmental concerns, steep hike in fossil fuel price, and increasing demand of non-renewable fossil fuels consumption have dramatically increased global search for alternative energies. The world requests ever growing energy supplies to sustain economic development and improvement. Renewable and sustainable energy ever more becoming accepted and established a decisive place in energy system of the world due to ecologically responsive insight and a decrease in equipment expenses. Consistent with its endowment of energy resources, each country tried to figure out its own energy portfolio and employing technologies, which are economically viable and socially equitable, and have minimal adverse impacts. This article attempts to review all possible renewable energy sources as a substitute of the current energy profile (coal, natural gas, and petroleum) in Afghanistan. The study found Afghanistan power sector as one of the least development sector which its inadequate status is preventing the development of the country as well. Eventhough, the energy is not the only panacea, but cost effective energies in abundant quantity and quality on sustainable foundation will help to reach to demand socio-economic development. The results indicate that Afghanistan due to its natural and geographical situations enjoys important prospective for renewable energy bases such as solar, wind, geothermal and micro hydro power. Renewable energies could offer the ultimate solution for Afghanistan in general, and rural areas in actual. But, switch to altered forms of energy is grounded in multifaceted interations. The study indicates number of issues such as great upfront charges, absence of providers, insufficient funding appliances, and feeble endorsed and methodological capability overwhelm and affected the use of renewable energies and technologies in Afghanistan. However, with sufficient investment and practical stages by government, and nongovernment agencies and the public encourage, these unbound sources could play a vital role not only in Afghanistan's energy supply, but also in poverty reduction, social and political stability, and improving living standard.

### 1. Introduction

Today, renewable energy sources have been becoming the backbone of our energy system and establish a decisive place in the 'future' energy system which is not far away when considering issues of greenhouse gas emissions and the finiteness of fossil resources as well as their uneven distribution over the Earth and the increasing political instability of precisely those regions most endowed with the remaining non-renewable resources [1]. On the other hands, fossil fuels as the first source of universal energy supply requirements (80% of entire energy

consumption) are gradually being substituted by renewable energy sources due to their environmentally welcoming attitude and a lessening in equipment charges [2]. Beside, carbon-based fuels are the main cause of greenhouse gas (GHG) releases, and CO<sub>2</sub> is the main contributor of GHG, and fossil fuel combustion accounts for 90% of the CO<sub>2</sub> emission [3,4]. The solution is to diversify the power supply including more and more renewable energy sources in order to ensure sustainability for future generations [5]. That is, considering upward concerns for sustainable future and energy security [6], clean energy sources are receiving major prominence across the globe [7]. Therefore,

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<http://dx.doi.org/10.1016/j.rser.2016.11.172>

Available online xxx

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Please cite this article as: Rostami, R., Renewable and Sustainable Energy Reviews (2016), <http://dx.doi.org/10.1016/j.rser.2016.11.172>

**Table 1**  
Renewable Energy Sources [9].

	Definition	Commercialized
<b>Solar thermal</b>	Energy from solar-heated fluid or Gas	Parabolic troughs
<b>Photovoltaic</b>	Energy from sunlight converted directly to electricity	Semiconductor solar cells
<b>Wind</b>	Energy from wind	Wind turbines
<b>geothermal</b>	Energy from heat stored under earth surface in hydrothermal reservoirs, geo pressured brine, zones, hot dry rock or magma	Hydrothermal extraction
<b>Biomass</b>	Energy derived from combustion, fermentation, gasification or anaerobic digestion of plant or animal matter	Landfill gas projects
		Waste-to-energy facilities
		Wood or agricultural waste burning plants
<b>Hydropower</b>	Energy from falling water	Store-and-release facilities (including pumped storage) Run-of-the-river plant

other energy sources such as renewables (see Table 1) which are perpetual, infinite and emission negligible CO<sub>2</sub> and greenhouse gases [8] has been considered.

Global environmental concerns and the escalating demand for energy open up new opportunities for utilization of renewable energy resources [2,10]. Renewable sources have become the backbone of energy system since 1873. Renewables then achieved a significant growth during 1980s because of political desire in reducing oil dependence and the social heat in reducing pollution [9]. From the end of 2004, worldwide renewable energy capacity grew at rates of 10–60% annually for many technologies. For example, wind power and many other renewable technologies, growth accelerated in 2009 relative to the previous four years [11] and more wind power capacity was added during 2009 than any other renewable technology [12]. Nonetheless, grid-connected Photovoltaic (PV) increased the fastest of all renewables technologies, with a 60% annual average growth rate [12].

But against all those primitive growth, today's global portion of renewable energy is not significant, around 17% of global energy consumption. However, its growth rate (except hydro and geothermal energy) [13–15] is notable (over 20%) compare to the past five years. According to Organization for Economic Co-operation and Development (OECD) *Factbook 2011–2012* [16], renewable energies involvement to entire energy stream improved from 4.8% in 1971 to 7.6% in 2010 for all OECD countries taken as a whole. However, this participation in non-OECD countries is greater than in settled OECD countries [16].

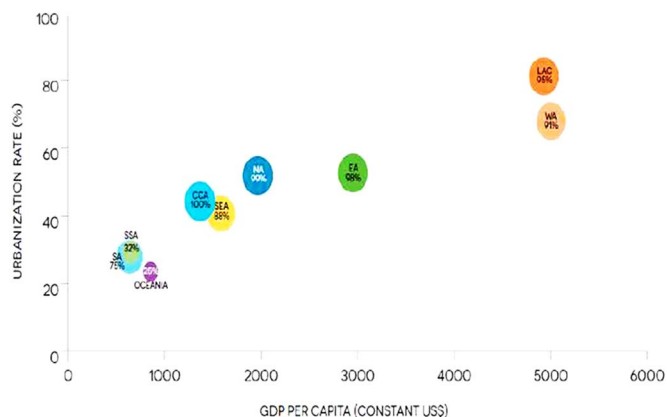
To reach sustainable development, over the previous three decades, a constant fixed of energy meters mostly rely on the extensive subjects of environment, economy, and society, has been established [17–19]. And, measurable gauges consist of electricity generation charges, Green House Gas (GHG) emissions throughout the entire technology lifespan, accessibility of renewable bases, productivity of energy transformation, land supplies and water intake [20] as critical for renewable energy (RE) technologies. However, other outlooks consider a figure of merit for comparison of the diverse RE structures according to their performance, net energy necessities, GHG productions and further gauges [21].

Objectives and strategies in renewable energies' employment doubled in 2010 compared to 2005. Grants and taxes have been engaged; and some schemes such as Feed-In-Tariff have been outlined to upkeep the growth of renewable energy strategies entirely [22–25]. And, the overall universal venture in renewable energy substantially improved and reached to 211 billion US\$ in 2011 compared to 2004 (22 billion US\$) [26]. Accordingly, the total growing ratio of renewable energies during 2005–2010 increased and reached to 49% for solar PV, 27% for wind power, 4% for geothermal and 3% for hydropower. Besides, around 20% of total electricity generation in 2010, which account nearly half of 194 GW electric energy supplemented to universe capacity in that year, was associated to altered sorts of

renewable assets [27].

Litretures on energy-economics varied from those that observed the short and long-run interactions between energy consumption and economic development [28,29], and energy consumption and economic growth [30–32]. Some i.e., [33–36] indicate that there is a strong fundamental correlation between energy and economic growth, but there is no compromise about trend of the interconnection. However, studies by Pesaran [37] (by using autoregressive distributed lag (ARDL) method), and Hatemi [38] (by applying asymmetric causality test approach) examined the pivotal relationship between renewable energy consumption and economic development of EU member countries during the period of 1990–2009. Their results show that renewable energy consumption has progressive influences on economic development for all countries, but there is statistically major influence on economic development only for some countries like Bulgaria, Estonia, Poland and Slovenia in compare to Cyprus, Estonia, Hungary, Poland and Slovenia. The main reason for these results based on Alper and Oguz (2016) [39] is the point that the new EU member developing countries explored in this study have fewer renewable energy in their energy assortment than other developed EU member countries. There is also inadequate indication on the effect of greater convenience of modern energy services on shortagedrop and income equality. Fig. 1 shows, greater charges of urbanisation and GDP display greater electrification amounts, with the exception of Western Asia and Latin America which report greater incomes and urbanisation amounts, yet poorer electrification amounts, than Eastern Asia and Northern Africa. In other words, access to new systems of energy, even though it is not by itself a solution to economic growth, is believed to be a pre-requisite for alleviating poverty, growing employment and, on the whole, endorsing well living standards [40].

Indeed, the access to modern and reliable energy facilities is an crucial effort to achieving most of the (See Fig. 2), including poverty alleviation, productivity, health, education, communication services



**Fig. 1.** Regional electrification by GDP and Urbanisation [41].

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