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Current scenario of the wind energy in Pakistan challenges and future perspectives: A case study

Mazhar H. Baloch [a,b,*], Ghulam S. Kaloi [a], Zubair A. Memon [c]

[a] Department of Electrical Engineering, Shanghai Jiao Tong University, Shanghai, China

[b] Department of Electrical Engineering, Mehran University of Engineering & Technology, SZAB Khairpur Mir's Campus, Pakistan

[c] Department of Electrical Engineering, Mehran University of Engineering & Technology, Jamshoro Campus, Pakistan

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ABSTRACT

Electricity plays an important role in the socioeconomic growth and social prosperity of any country. It is to be considered as the basic need for human development. Nowadays, low production of electricity is a serious problem in Pakistan, which directly restricts the development of the state. One-third of Pakistan's population does not have any electricity in the rural areas and about 10–12 hours load shedding in urban areas and is quite common. Although, the state of Pakistan always shows a deficit in the conventional resources, but no progress was also being made in the renewable resources such as the wind and solar energy. Therefore, it is better to utilize these natural assets in order to fulfill the electricity supply the country. In this manuscript, our main objective is to study and outlooks the country energy profile situation vis-à-vis wind energy potential characteristics of the most important wind corridor in the southern part of the country. Pakistan has around 1100 kilometers (km) coastal line for the wind energy potential, but in this manuscript, we have chosen one of the most suitable wind corridors of the southern part of the country. We also tried to prove theoretically that this wind zone is more favorable for country consumer demand. Moreover, future perspective and the major challenges during windmill implementation is also being discussed herein.

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1. Introduction

Energy is the fundamental necessity for the human and socioeconomic development of a country. Furthermore, a simple way in order to express the growth of a country is the energy contribution per capita. it was reported that the production ratio of fossil fuel for North America, Europe, and Pacific Asia to be about 10, 57 and 40 years respectively, and it is necessary to reduce reliance on oil as referred to (see Makkawi et al., 2009). Moreover, the Pakistan energy need is highly dependent on oil, liquefied gasoline and natural gas. These sources contribute about 85% of the whole electricity supply for the country, while, the contributions of coal, nuclear and hydroelectricity are about 4.5%, 1.1% and 9.2%, respectively (Harijan et al., 2009; Clarke and Trinnaman, 2004; Khan and Qayyum, 2009; Mirza, 1995). In 1947, after the independence of Pakistan, the total power generation was around 60 MW for its 31.5 million residents *i.e.* ∼4.5 units/consumer. It is important to note that, it was not enough, even at that time to fulfill the requirement of the consumers. Moreover, with a rapid growth in modern and social life, there is a tremendous increase in demand for the production of electricity. At the end of the 1970s, the power production reached up to 1.3 GW with the installation of different power houses. After the 1980s, power production increased and touched with the power network up to 3 GW. Ten years later the power production capacity was about 7 GW. In 1998, the whole power sector was restructured laid with the foundation of the Pakistan Electric Power Company (PEPCO). It is stated that before 1998, there were only two electric utility companies, one was the Karachi Electric Supply Company (KESC) served in Karachi region, whereas, another was the Water and Power Development Authority (WAPDA) which served for the rest of the country. Afterwards, it has been restructured a wing power in WAPDA in order to separate commercial entities, which make up of four generation companies (GENCOs), and eleven distribution companies (DISCOS) and one transmission company National Transmission Despatch Company (NTDC). Ten distribution companies are responsible for delivering electricity to the consumers, and KESC is responsible for organizing the total demand for its personal production in addition to buying from NTDC,

* Corresponding author at: Department of Electrical Engineering, Shanghai Jiao Tong University, Shanghai, China.
E-mail address: mazhar.hussain08ele@gmail.com (M.H. Baloch).

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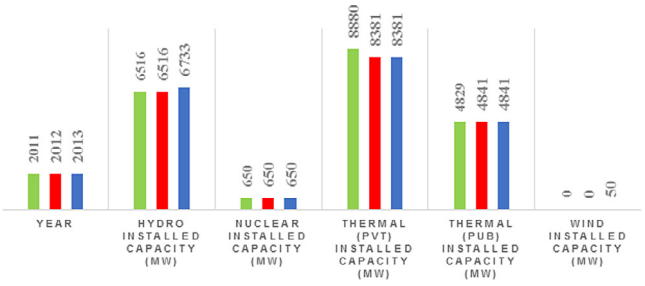

Fig. 1. Installed power sectors in Pakistan.

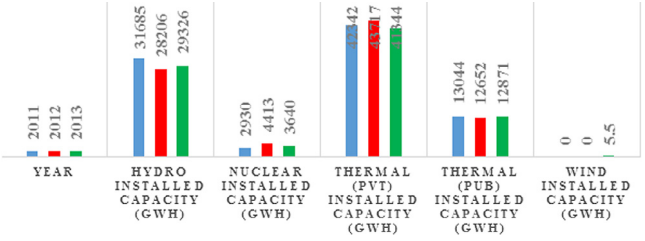

Fig. 2. Power generation sector wise.

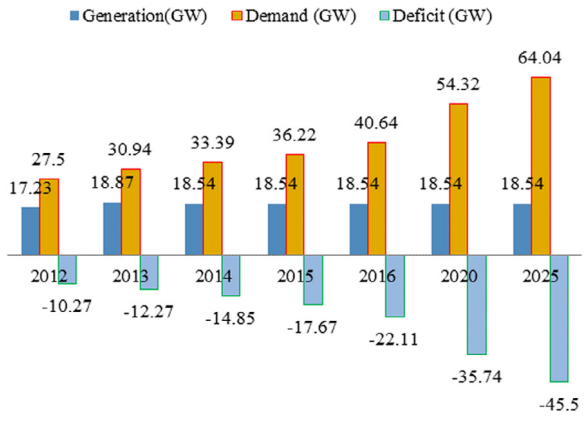

Fig. 3. Pakistan power generation, demand and deficit in different years.

Independent Power Producers (IPPs) and Karachi Nuclear Power Plant (Kanupp). In the 2000s, the annual electricity use in the residential sector had been increased per consumer and each annual industrial client also reached at the peak level in the widening gap between supply and demand. In the year 2006, the Asian Development Bank reported that about 45% of Pakistan residents lacks the basic need of electricity (Yearbook, 2003). In 2008, there were a worsened power crisis conditions in Pakistan, and the power shortage has increased by 4 GW.

The Pakistan installed power generation capacity outlooks by the year 2011–2013 including all generation sources is depicted in Fig. 1. It is clearly observed that, the thermal (Pvt) power plant uses the oil/gas sources for the power production. As referring to the (see Saadi et al., 2012), the power generation capacity sector wise in the year 2011–2013 is depicted in Fig. 2, the different sources have been utilized for the generation of electricity even wind, but here it is again reminded to the readers that the wind potential contribution percentage is negligible for the generation of electricity.

As we know that, Pakistan is an electricity deficit country, and in the near future, the electricity crises intensity will be at a maximum level (Mian and Khwaja, 2004). In the year 2012–2015, electricity crises situation increases 3% per year as depicted in Fig. 3.

Fig. 4. Pakistan 1st 50 MW wind power plant (Zorlu energy Turkish company) 2012.

Fig. 5. Pakistan 1st 100 MW solar power plant (Chinese company) 2015 (Tso and Yau, 2007).

It is reminded to the readers that, matter-of-fact that free source such as a huge wind and solar energy potential available in large amount yet not being intended to be exploited for the generation of electricity (Baloch et al., 2015a,b). In which one of the example Zorlu energy from Turkish company installed around 50 MW at Sindh wind corridor near Jamshoro city in 2012 as shown in Fig. 4, and the grid based solar farm around 100 MW installation with the collaboration of Chinese company is located within the Quaid-e-Azam Solar Park in Bahawalpur, Pakistan in 2015 as shown in Fig. 5.

It is reminded to the readers that, globally renewable energies such as: solar, wind, could meet the rapid demand of the consumer, and it could fulfill the increasing power shortages demand of the Pakistan. It is reminded to the readers that, globally renewable energies such as: solar, the wind, could meet the rapid demand of the consumer, and it could fulfill the increasing power shortages demand of the Pakistan (Harijan et al., 2009). In this research study, we initiate and investigated one free energy zone namely Jamshoro city Sindh province for power generation from southern part of Pakistan, where the maximum wind speed reaches around 14 m/s.

The literature was carried out using IEEE Explore Digital Library (Musial and Ram, 2010), Google Scholar (Heymann, 1998), Science Direct (Jonkman and Musial, 2010) and Research Gate (Gipe, 2009). The key terms searched on these data engines were '*wind energy systems*' and '*wind energy profile situations in Province of Sindh Pakistan and world*' etc. Furthermore, all the searched research articles were properly checked and the appropriate article related to our problem were included in the literature survey. However, major consideration has been given wind energy performance in Sindh (Pakistan) main corridors, wind speed and proper selection of windy zones.

2. Global investment on clean energy sector status

Globally, most of the conventional sources (which produces CO_2) dependent countries are trying to shift their power houses on renewable sources because conventional sources will be exhaust in the future. Therefore, we put an immediate attention in

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