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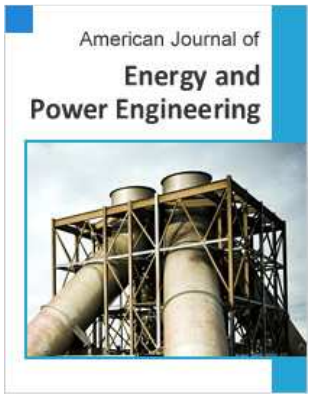

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Wind Energy Development Policies in Developing Countries and Their Effects: Turkey, Egypt and Prospects for Pakistan

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Abstract
In many developing economies, faces have now started turning towards wind energy generation and regulations are adapted or put in place for this new use of the wind. This paper investigates policies that support implementation of wind energy, and their effects have been examined in perspective of three developing countries: Turkey, Egypt and Pakistan. The wind energy generation targets and the related promotional policies being adopted have been analyzed. A frame work, consisting policies for price setting and quantity forcing, cost reduction and public investment, market facilitation and grid interconnection regulations was selected for the comparative analysis. For each country the above areas were attended to see which regulation is favorable, unfavorable or under discussion by the policy makers. Finally the regulations and effects have been compared and possible changes have been discussed for policy and regulation in wind energy in Pakistan.

1. Introduction

The beginning of twenty first century is an exciting time for wind energy. With the changes in technology, policy, environmental concern and changes in electricity industry infrastructure, the coming years offer an unparalleled opportunity for wind energy to emerge as a viable electricity source, on a environmentally sustainable development path [1]. Yet the challenges facing wind energy remain both substantial and complex, particularly in the case of developing countries. These barriers while being situation specific in any given region or country nevertheless have been due to dominance of conventional energy technologies, high initial capital costs, variation in output, issues of dispatch ability, and due to the weaknesses in institutional, financial and legal frameworks. Further in many developing countries, utilities are still an arm of the government and subject to political control, endangering the reliability of the long term revenue. To deal with these barriers it is, therefore, essential to introduce policy interventions that can support this new use of wind. The achievement of investor's confidence through these policy interventions is considered as the most important target and depends on the appropriate guards set in place to address the perceived financial risks and regulatory uncertainties[2].In this paper we have made an attempt to analyze that what appropriate policies and regulations Turkey, Egypt and Pakistan have adopted for effective wind power generation.

2. Methodology

Initially a brief introduction has been made to each country and its electricity market. Next the wind power potential and generation environment for each country has been discussed. This followed by a comparative analysis of the promotional policies and regulations being practiced. It is examined which of the policies and regulation have enhanced the development of wind energy and lowered the financial risk and regulatory uncertainties. The frame work adopted for the purpose of these investigations was restricted to the six policies and related instruments shown below. In the end, based on this analysis certain direct and indirect policy instruments have been recommended for accelerated generation of wind energy in Pakistan.

a. Price-setting and quantity-forcing policies.
b. Cost reduction and public investment policies.
c. Market facilitation and interconnection policies.

3. Introduction to the Countries

3.1. Pakistan

Pakistan is a South East Asian developing country bordered by Afghanistan, Iran, India, China and Arabian sea. Pakistan's estimated population is slightly close to 200million people [3]. With sixth most populace country in the world, it has a total area of 803,940 km^2.The per capita income of nearly 2600 US$, is regarded as a country with low income level. Total power generation capacity of Pakistan for year 2013 was 22,797 MW. The primary energy sources for electricity generation by fuel can be broadly divided in three equal shares of parts of hydro, thermal (gas and oil, coal) fired plants and nuclear power plants as shown in figure-1(A). As of consumption, the domestic sector accounts for the largest part with a 45.8%followed by industrial 29.0% and agriculture as 11.2 %depicted in figure-1 (B)[4].

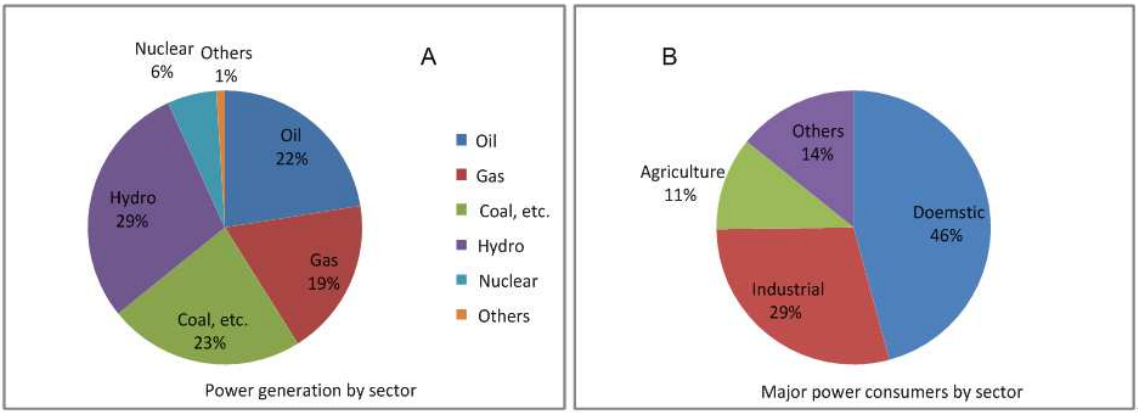

Figure 1. *Pakistan power (a) generation by source and (b) major consumers by sector.*

Pakistan is currently facing a severe and multifaceted energy crisis. Electricity shortages exceeded 7,000 megawatts. On the other end a good condition for wind power development can be found in many parts of Pakistan to mitigate these energy crises like Gharo Sakro corridor, with an estimated amount of 50,000MW of exploitable potential. Others areas include south western region near Iran and in the region around Islamabad. The total potential for wind energy development in Pakistan is estimated about 346,000MW [5]. The National Renewable Energy Laboratories (NREL) USA and Alternate Energy Development Board (AEDB) Pakistan under US aid program have developed the wind resource map of Pakistan.

Whereas, Zorlu Enerji wind project of 50 MW is the country's first ever wind power plant of Pakistan. So far 255.4 MW has been commissioned and 479 MW wind power plant are under construction. The ministry of water and power is responsible for formulating Pakistan wind energy policy. The policy for Development of renewable Energy for power generation(2006), sets out policies and strategies for electricity generation projects utilizing wind. A draft policy for the midterm is under discussion with the policy makers and is expected to be promulgated soon. For wind power the short term plan is to develop a cumulated capacity from wind energy of 680MW by year 2010, 3730MW until 2020 through midterm plan and 9700MW by 2030[6].

3.2. Egypt

Egypt is located in the northern Africa bordering the Mediterranean sea, between Libya and the Gaza strip, and the Red sea north of Sudan. Its estimated population is close to86.9million people[3] and a total area of 1,010,407.87Km^2withper capita income nearly 6000 US $. Egypt experiences frequent electricity blackouts because of rising demand, natural gas supply shortages, aging infrastructure, and inadequate generation and transmission capacity. Total installed generation capacity for the2012-13 was 30,803 MW, conventional steam power stations accounted for 44.82%, combined cycle power plants of 32.72%, and hydro power stations for 9.09%. renewable energies generation provide the remaining 2.23% as showing in figure-2. Whereas the main consumer of electricity in Egypt

is the residential sector which accounts for the 37% of the total consumption followed close by the industrial sector 35% [7].

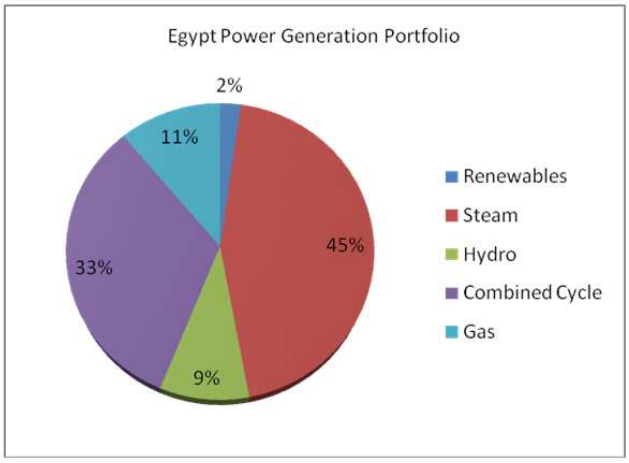

Figure 2. *Egypt power generation.*

Egypt has an outstanding wind energy conditions. The country's large deserts and abundant thinly populated areas are well suited for the construction of large wind farms. A special wind atlas for thegulf of suez was completed in 2003. The assessment determined an overall potential capacity of 20,000 MW for wind power projects in the uninhabited desert regions to the west of the Gulf[8]. Three locations Sidi Barrani, Mersa Matruh and El Dabba- found to also exhibit suitable characteristics for the installation of wind turbines. Egypt started its wind energy program in 1999. According to NREA, Egypt with has5.2 MW pilot plant and demonstration wind farm in Hurghada. The current installed capacity accounts for 545 MW, with almost all of it in the Zafrana area on the coast of Red sea[9] The wind farm houses a number of wind projects that were developed in several stages and financed in cooperation with development banks from Germany, Denmark, Spain, and Japan. The government plans to expand wind capacity over the coming years as part of a plan to increase wind generation to 7.2 GW by 2020.

The ministry of electricity and energy established new and renewable energy agency NREA in 1986 for the purpose of bundling activities aiming to promote renewable sources. All existing wind farms in Egypt are owned and operated by NREA[10]. Egypt's renewable energy policy was formulated in the early 1980s as an integral part of national energy planning. The strategy has been revised and adopted according to the changing financial, market, and technological framework. With the scope of Renewable energy strategy, 12% of total electricity supply by 2020 is to be generated by wind power, translating into more than 7,200MW of grid connected wind farms. In order to reach these targets, in February 2008 the Egyptian Supreme council of Energy approved a plan to build 600MW installed wind capacity per year during the next 12 years amounting 7,200MW in 2020. To implement this strategy a two phased policy is planned in the new Law. As a matter of fact, RE has received more attention and growth due to the existence of a national organization (NREA) taking the responsibility of developing its activities.

3.3. Turkey

The Republic of Turkey, located in South-eastern Europe and South-western Asia (that portion of Turkey west of the Bosporus is geographically part of Europe), has an area of about 783,562 Km^2 and a population of over 77.69million [3]. The per capita income is 11200 US $. Turkey's total electricity production and installed capacity for the year 2012-12was about to56GW.Turkey's primary energy sources for power generation include hydropower, geothermal, coal, oil and natural gas and renewable energies. The distribution of the produced electricity energy according to primary energy sources is depicted in gigure-3 [13].Turkey has a land surface area of about 783 thousand km^2surrounded by mountains, Its unique geographical character creates a regular and moderate air inflow through mountainous straits and passages, the wind energy corridors are between the colder European and warmer Asian and African systems which causes a wide variety of temperature and climate difference. Based on the examination of the Wind Atlas of Turkey, it may be concluded that the regions of Aegean, Marmara, and East-Mediterranean have high wind energy potential. Turkey's annual theoretically available potential for wind power is calculated to be more than 80,000 MW, about 10,000 MW of which is also economically feasible [15].

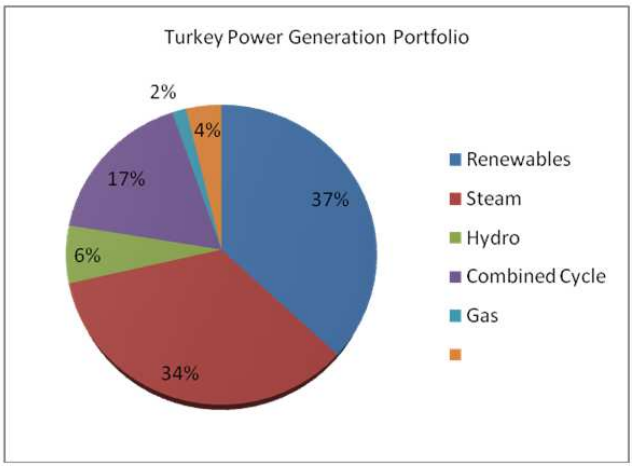

Figure 3. *Turkey power generation.*

In Turkey, electricity generation through wind energy for general use was first realized in Izmir in 1986 with a 55 kW nominal wind energy capacity. However, the utilization of wind energy in Turkey has increased since 1998 when the first wind power plant with a total capacity of 1.5 MW was installed. So far, Turkey has more 2000 MW wind power installed capacity in operation and about 600 MW under construction. Also, EMRA issued licenses for about 2,500 MW wind power capacity and license applications for a total capacity of 78,180.2 MW have been submitted to EMRA by private developers.

Existing Turkish law and regulation with relevance to the use of renewable energy sources is limited to two pieces of legislation. One piece of legislation is the Electricity Market Licensing Regulation, and the second is the Law on

Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (Law Number 5346, dated May 10, 2005). As indicated by the titles, this legislation has been developed for the electricity sector. In both regulations, wind power is included in the definition of renewable energy resource[14].

4.Policy Analysis

4.1. Price-Setting and Quantity-Forcing Policies

The two most widely-used market deployment policies i*n the electricity sector* are the price-setting regulation (also known as the feed-in-tariff, or FIT) and the quantity-setting regulation or quota obligation (commonly referred to as renewable portfolio standards, or RPS)[17]. Price-setting policies reduce cost- and pricing-related barriers by establishing favourable pricing regimes for wind energy relative to other sources of power generation. Quantity-forcing policies mandate a certain percentage or absolute quantity of generation to be supplied from renewable energy, at unspecified prices [18]. As of quantity forcing policies all the three developing countries under discussion have a predetermined quantity forcing targets specified in their energy policies for wind generation , but no transparent mechanism has been set in place to meet these obligations at the consumption end(like RPS).However in Turkey, according to the new law, each legal entity possessing a retail sale license is required to purchase renewable electricity in an amount declared by EMRA [14].For price setting policies determination of FIT is under discussion by the policy makers of all the three countries. In Turkey the applicable price for the wind electricity to be purchased is to be the Turkish average wholesale electricity price in the previous year determined by EMRA [14]. In Egypt the procurement cost of electricity from wind farms is not set based on financial costs of SVC analysis rather, they are set in comparison with the cost of electricity generation from thermal power stations Wind producers in Egypt thus received a payment based on value of a subsidized avoided fuel costs[11]. The price setting policies in Pakistan is negotiation based. The tariff is being determined on the basis of negotiations between the NEPRA and the wind power producers [6]. Nevertheless determination of fixed feed in tariff is under discussion by the policy makers of all the three countries.

4.2. Cost Reduction and Public Investment Policies

Cost reduction policies are designed to provide incentives for voluntary investments in wind energy by reducing the costs of such investments. These policies include direct subsidies and rebates, tax relief, loans, grants and other financial assistance. public investment activities or public funds for renewable energy development are raised through a System Benefits Charge (SBC), which is a per-kWh levy on electric power consumption. Similar levies exist in U.S and some European countries [18]. No mechanism have been introduced to achieve public investment funds for the promotion of wind energy in any of the three countries, however, Egypt has established a renewable energy fund which will be mainly financed through a levy on subsidized fossil fuel sales for electricity generation[11]. These funds serve a variety of purposes, such as paying for the difference between the cost of renewable and traditional generating facilities, reducing the cost of loans for renewable facilities, supporting R&D and etc. Numerous tax relief schemes are available to the wind power producers of the three countries. For instance in Pakistan and Turkey wind power generation and equipment is exempted from excise taxation and customs duties, whereas in Egypt equipment and components as well as the spare parts of wind energy are subject to only 2 % custom tax of the value. Egypt also has the privilege of enjoying the concessionary loans and grant schemes for its national wind farms[16], in year 1993, followed by Turkey in year 2001. As all of the wind farms in Egypt are owned by the government, the government purchase has also facilitated the cost reduction. However there is no experience and transparent policy mechanism set in place for canalizing the grants and loans for wind farms in Pakistan.

4.3. Wind Energy Market Facilitation and Interconnection Regulations

Market facilitation supports market participants and encourages wind energy technology deployment. This includes institutional structure, support policies for accelerated wind mapping, sitting, permitting and land acquisition. AEDB in Pakistan and MNREA in Egypt have been instrumental in developing such policies for their countries with quite success. In Turkey, however there is a need in establishment of a structure at the institutional level, which requires a higher level of coordination and cooperation within and between institutions, agencies and other stakeholders [14].Further, there is insufficient detailed wind energy resource assessments and data banks available. Provisions of net metering, mandatory purchase, banking, preference in interconnection, wheeling and priority dispatching is available to the wind producers. However policies to develop infrastructure of electrical networks and grid interconnection at high wind locations are not well developed and needs further deliberation by the policy makers.

5. Policy Recommendations for Pakistan

Pakistan is experiencing an acute energy crisis. Electricity shortages exceeded 7,000 megawatts in year 2012-13. The energy shortages are estimated to cost around 2 percent of GDP annually. This shortfall is the result of the failure, over successive governments' tenures, to invest enough to expand power system capacity.

The shortfall in generation stems largely from a cumulative

failure to achieve the investment levels needed to expand and maintain power generation on pace with the growing demand. This lack of investment, along with the lack of consensus on, for example, a number of hydropower projects, has prevented the energy sector from developing new, cheaper, domestically available fuel sources, such as coal or hydroelectric power, forcing continued reliance on imported fuel oil and dwindling natural gas reserves.

In the light of above analysis of prospective policy instruments and guidelines of Egypt and Turkey to mitigate their energy crises by utilizing the renewable energy resources. As discussed above that Pakistan has estimated about 346,000 MW of wind energy potential. Therefore, governments Pakistan need to follow and adopt Egypt's and Turkey's policies concerning with wind power utilization which may to include promote the development of the power sector in Pakistan.

a. A parallel policy for development of government owned and operated wind projects as is being practiced in Egypt. This will not only reduce the cost but will also help in learning wind project dynamics which will in turn be very beneficial in determining future policies and progress.
b. A more elaborate mechanism of generating funds from Loans, bilateral and multilateral grants for wind power projects in Pakistan. Egypt's experience can be taken as guidelines for the persuasion of this policy.
c. Expeditious determination of a legalized or location specific feed in tariff for wind power projects.
d. A target for the penetration of wind power into the energy market by a given year to ensure the country stays on track with the goal.
e. Financing of public benefit funds with suitable levy mechanism. Egypt has established a renewable energy fund which will be mainly financed through a levy on subsidized fossil fuel sales for electricity generation. These funds serve a variety of purposes, such as paying for the difference between the cost of renewable and traditional generating facilities, reducing the cost of loans for renewable facilities, supporting R&D and etc.
f. The policies for Industrial recruitment of wind turbine manufacturing facilities in areas of high wind potential are to be elaborated, so that local jobs and local manufacturing can be supported in these areas. Pakistan should create the favorable conditions for wind power manufacturing factories, which allows creating new work places on one hand and reducing transportation expenses on the other hand.
g. Infrastructure development policies like a more autonomous, extended authority and responsibility for the AEDB for wind generation as is the case with MNREA in Egypt. This also includes operation of government owned wind farms.
h. The infrastructure of electrical networks at high wind locations should be reinforced of as a matter of priority this specifically includes areas around Hyderabad and Kallar Kahar.
i. The long term plan should have a more transparent policies for Quota fixing or quantity forcing policies. As is the case in Turkey where according to the new law, each legal entity possessing a retail sale license shall be required to purchase renewable electricity in an amount declared by EMRA.
j. Pakistan should also draw some lessons from technical solutions and business and regulatory practices developed in some countries to help the integration of large wind capacities into main electricity infrastructure of the country.

6. Conclusion

The successful beginning in the exploitation of wind energy in developing countries like Turkey an Egypt has many lessons for other aspirant countries like Pakistan. The promotional policies adopted in these developing countries while being region or country specific, nevertheless, provide an insight for changes or adoption in the wind energy policy of Pakistan. Part or all of these recommended policies can be considered by the policy makers for accelerated development of wind energy generation in Pakistan.

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