COMPETITIVE ADVANTAGE OF WIND POWER INDUSTRY FOR TURKEY: ANALYSIS OF FACTOR CONDITIONS IN PORTER'S DIAMOND MODEL

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ABSTRACT

The wind energy vision and the official goal of Turkish Ministry of Energy is to achieve 20,000 MW installed wind power capacity by 2023. Turkey had an installed capacity of 796 MW at the end of 2009. Achieving the wind energy vision by 2023, in 13 years, requires 24 times increase in installed wind power capacity. Sustaining such an ambitious performance requires a systematic growth in wind power industry. This systematic growth may be achieved via building a competitive industry. We used Porter's diamond model to analyze the competitive advantage of Turkish wind power industry. This model is a widely recognized model for analyzing competitiveness of nations. As the first step, in this paper, we analyzed the factor conditions in Porter's diamond model. Our analysis indicated that Turkey's factor conditions in wind power industry looks promising and there is potential. However, this potential is only useful when it is properly used as the input to the system to build and sustain the competitiveness of Turkish wind power industry.

1. INTRODUCTION

Turkey is a fast developing country and the economy has expanded significantly in recent years. To achieve and sustain stable and constant growth in economy, Turkey has to meet the increasing energy demand while securing adequate supply of energy. Currently, Turkey's energy demand is mostly supplied through fossil-based fuels. Since Turkey is not a rich country in terms of fossil-based fuels, Turkey has to import a great deal of fossil-based fuels. The rise and fall of oil prices deeply affects Turkey's economy. As a result, Turkey has to find ways to increase the share of energy supply through renewable resources including hydro, solar, wind, geothermal, wave and other renewable resources to be utilized in the future.

Wind power is the fastest growing renewable energy alternative and Turkey has a promising wind power potential. Therefore wind power is attracting attention among other renewable energy alternatives. To create competitive advantage in international scale and to constitute a road map for wind power industry, Turkey must analyze the technical, economical and environmental issues of the wind power industry. This industry is currently at its infant phase in Turkey.

Porter's diamond model [1] is a widely recognized model for analyzing competitiveness of nations. The model is an important work relating strategic management to international economy [2]. Porter's diamond model has four main and two additional attributes. The main attributes are factor conditions, demand conditions, related and supporting industries, and firm strategy, structure and rivalry. The two additional attributes are government and chance.

Academicians used Porter's diamond model to analyze the competitive advantage of a national industry or enterprise. For example, Karácsony used the model to analyze to competitiveness of Hungarian wheat sector [3]; Liu and Song tested the model in China [4]; Oz used the model to examine five industries in Turkey [5]. The industries included in Oz's study are glass, construction, leather clothes, automobiles and flat steel industries. Bakoğlu tested the demand conditions in the Diamond Model in apparel industry in Turkey [6]. Doegl and Holtbruegge analyzed competitive advantage of German renewable energy firms in Russia using the diamond model [7]. Bellak and Weiss proposed an Australian diamond [8]. Rugman and D'Cruz demonstrated that Canada's international competitiveness is not explained by the Porter's home country diamond as Canada is a member of NAFTA, claiming the diamond model valid for explaining success of Japanese, American and E.C.- based multinationals, i.e. the triad [9]. Although there are a few studies indicating that the Rugman and D'Cruz's double model is more valid in New Zealand [10] and in Mexico [11], Porter's Diamond is used as a widely recognized tool of national competitiveness in the literature.

Zhao, Hu, and Zuo conducted a very similar study to analyze performance of wind power industry development in China [12]. They applied a revised model of Porter's diamond model to their study. In their model, government is another main attribute rather than being a secondary element and technology is added as a key factor between demand conditions and firm strategy, structure, and rivalry. Their reasoning for adding the government as a fifth attribute was that government plays a key role in wind power industry. For each attribute in the diamond model, they analyzed the issues. In our study, we only focus on the issues related to one of the attributes and that is factor conditions in wind power industry. Furthermore, we use Porter's original model and we follow the categories of factor conditions as originally presented in Porter's work [1]. This study is only the first step in our goal to investigate the competitive advantage of

wind power industry for Turkey.

The rest of the paper is organized as follows. The second section briefly describes the importance of renewable energies and wind power energy for Turkey. Porter's diamond model is explained in the third section. Section four discusses factor conditions in detail. Finally, we conclude the paper with identifying opportunities for future work.

2. IMPORTANCE OF RENEWABLE ENERGIES AND WIND POWER ENERGY FOR TURKEY

The general outline of an energy system structure may include industrial, transportation, residential and commercial demand sectors, directly and dynamically dependent to the supply side. Besides, equilibrium must be provided between both the supply and the demand sides while these demands are all covered. Although the most of neighboring countries located at the southeastern border of Turkey are fuel-rich; the country doesn't have a contributing economical potential of fossil fuels. Diversification of energy resources in the country is important in terms of supply security concerns; but also setting up the fuel mix independent or taking it at a minimum level of importation is a priority in a national benefits oriented energy policy.

Turkey changed its energy policy concerning the use of oil after the two oil crises. Following the domination of oil, natural gas has recently become more used fuel, and the consumption has grown rapidly. Looking at the share of energy sources in Turkish electricity generation in 2005; natural gas comes at the first place with 43.8%, hydroelectric takes the second place with 24.6%. Natural gas imported to Turkey comes from the Russian Federation (Blue Stream, Turusgaz and West), Iran, Turkmenistan, Azerbaijan, Algeria (LNG) and Nigeria (LNG). However, long-term "Take or Pay" natural gas supply contracts create additional distress for the economy of the country, especially with the less gas consumption and narrowing effects of economical crisis on industrial subsectors.

In Turkey, the demand for electrical energy is primarily met from thermal and hydraulic resources. The shares of the renewable energy resources, such as geothermal and wind energies are currently very low in comparison with conventional resources, although the country has a huge technical potential in terms of renewable energies. This will contribute to the country's energy economy and create additional employment and new investment areas.

Besides energy point of view; the main objective of Turkey's environmental policy is defined as environmental protection and improvement in the context of sustainable development. The basic principle of this policy is to achieve sustainable development through natural resource management, and protection of human health and natural equilibrium, and to bequeath a livable natural, physical, and social environment to the future generations. Over the past decade, an overview of Turkey's actions aiming at reducing and/or limiting the levels of greenhouse gases caused by different sectors shows that energy conservation proved to be the most successful means of mitigation. Energy conservation, together with new and renewable energy technologies, appears to be the most effective and principal policy instrument and technological option for the future of Turkey. Because the main reason for the greenhouse gas emissions is the industry sector and power generation.

During the United Nations Framework Convention on Climate Change (UNFCCC) negotiations, the most distressing problem for Turkey was the lack of alternative scenarios that could be used as the basis for calculating the costs of reducing greenhouse gas emissions, particularly in the energy sector, as well as setting quantitative targets for emission reductions. From that time on, the development of alternative scenarios for reducing greenhouse gas emissions caused by energy consumption has been one of the most important items on the agenda of national climate change studies. The countries that sign up to the treaty are legally bound to reduce worldwide emissions of six greenhouse gases by an average of 5 % below their 1990 levels by the period 2008-2012. The protocol came fully into force on February 2005, the pact needed to be ratified by 55 countries accounting for at least 55% of 1990 carbon dioxide emissions to ratification came when Russia signed up to the agreement on 5th November 2004. The protocol is officially the first global legally binding contract to reduce greenhouse gases. The EU has already promised to reduce the emissions by 8% from their 1990 levels. UNFCCC was held in Bali on 3-14 December 2007 and evaluated as an important political breakthrough. Upon Turkish Parliament approval of Kyoto Protocol, the modest first phase is to be succeeded by a series of new agreements and to be negotiated during the coming years. Turkey will have to stabilize the greenhouse gas emissions at a designated level.

Wind power is the fastest growing renewable energy source and Turkey is a rich country in terms of wind power. A systematic and carefully planned growth in wind energy industry helps Turkey to realize the wind energy vision. As a result, there lies an opportunity for Turkey.

3. PORTER'S DIAMOND MODEL

Porter's diamond model is mainly used to investigate the national competitive advantage in a specific industry [1]. The diamond model has four main and two additional attributes. The main attributes are factor conditions, demand conditions, related and supporting industries, and firm strategy, structure and rivalry. The two additional attributes are government and chance. All these attributes interact with each other and they form a dynamic system. Porter calls it the

system of determinants of national competitive advantage. According to Porter, nations become successful in international competition when they acquire advantages in this dynamic system. Porter's research shows that of the four main determinants, domestic rivalry and geographic clustering are particularly important. Domestic rivalry promotes improvements in the other three determinants and geographic concentration magnifies the interaction of the four separate influences [1].

Factor conditions are the values the country possesses. These values include labour, natural resources, knowledge resources, physical resources, technology, infrastructure, skilled person, human resources, etc. Factor conditions can also be thought as inputs to the dynamic system of determinants of national competitive advantage.

Demand conditions are related to the quality and sophistication of demand in a particular industry. Porter stresses the importance of home demand. Related and supporting industries and firm strategy, structure and rivalry in the nation are the other two determinants in Porter's diamond model.

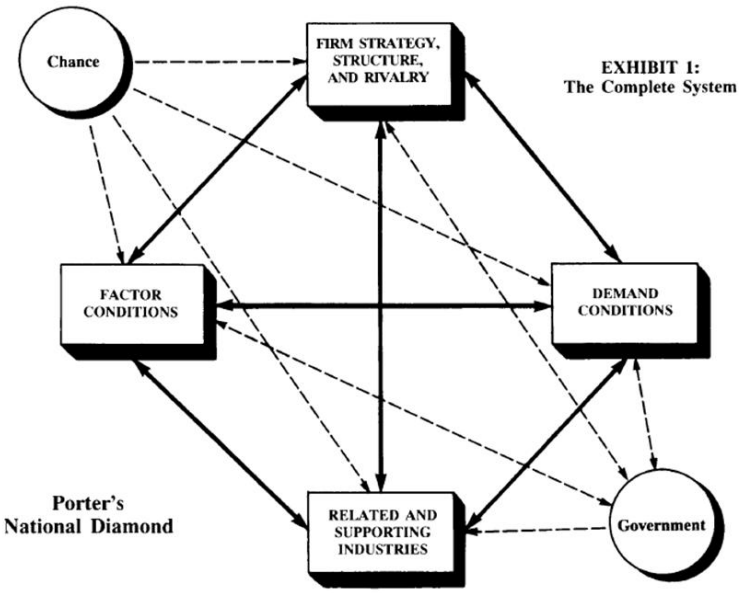

Figure 1. Porter's Diamond Model – Taken From [13]

4. FACTOR CONDITIONS

We analyze factor conditions of Turkey's competitive advantage in wind power energy industry in the following categories: human resources, physical resources, knowledge resources, capital, and infrastructure.

4.1. Human Resources

Quality and availability of human resources is an important factor in any type of industry. We have identified a list of expertise that is needed in establishing and sustaining competitive advantage in wind power industry. The expertise required in engineering comprises of mechanical, control systems, electrical and electronics, civil and other closely related engineering areas. In addition to able engineers, skilful technicians are also needed. Crane operators to build wind farms, control systems technicians to monitor day-to-day operations of wind farms and grids, mechanics and electricians to maintain the farms are among the technicians required in wind power industry. During the last decade, Turkey has significantly increased the number of universities and engineering programs. There are also improvements in acquiring necessary faculty to sustain these universities and programs. Government supported state universities will open 5000 new positions in a variety of areas. The human resources in engineering areas are expected to be adequate to support wind energy industry.

Naturally, engineering is only one aspect of required human resource in establishing and sustaining wind power industry. Other types of expertise are also required. Some of this expertise must be specialized in providing necessary services to wind power energy industry. Project managers specialized in building wind farms and managing day-to-day operations of these wind farms are among the required human resources. Insurance specialists are needed to provide necessary services to companies operating in this industry. Financial consultants specialized in the dynamics of overall energy sector and especially wind power sector may help companies to acquire necessary funds. Acquiring necessary licenses is an integral part of doing business in this industry. Therefore, consultancy in licensing issues should be provided. Lawyers provide legislative support to the stakeholders in this sector. Since wind power industry is considerably small in Turkey, the experts and expertise in most of these areas are limited. Necessary human resources and expertise will build up as the industry grows.

Scientists and researchers in all of the mentioned areas should support the overall industry in a variety of ways. Currently, there are improvement opportunities in this area.

Figure 2 shows direct employment by type of company in wind power industry [14]. The survey was conducted in 2007.

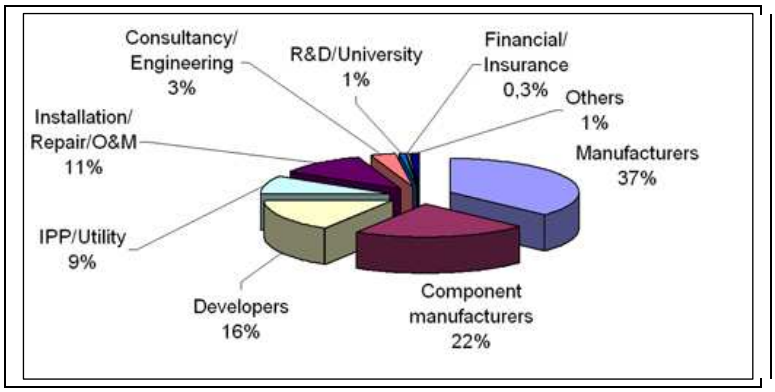

Figure 2. Direct Employment by Type of Company, EWEA Survey - Taken from [14]

Table 1. Direct Employment from Wind Energy Companies in Selected European Countries, EWEA Survey - Taken from [14]

Table 5.3: Direct employment from wind energy companies in selected European countries

Country	No of direct jobs
Austria	700
Belgium	2000
Bulgaria	100
Czech Republic	100
Denmark	23,500
Finland	800
France	7000
Germany	38,000
Greece	1800
Hungary	100
Ireland	1500
Italy	2500
The Netherlands	2000
Poland	800
Portugal	800
Spain	20,500
Sweden	2000
United Kingdom	4000
Rest of EU	400
TOTAL	**108,600**

Source: Own estimates, based on EWEA (2008a); ADEME (2008); AEE (2007); DWIA (2006); Federal Ministry of the Environment in Germany, BMU (2008)

Installed wind power in EU-27 countries by the end of 2007 is 56,517 MW. In 2007, the total number of direct employment from wind energy companies in Europe is around 108,200 excluding the number of jobs in the rest of EU category. In Europe, the total number of direct and indirect jobs is estimated to be at 154,000 based on 2007 figures. The

average number of direct jobs per MW is around 1.91 jobs/MW in Europe. Table 2 shows the average number of jobs per MW for European countries having installed wind power more than 2000 MW. The average is quite high in Denmark. Since Denmark is an important wind power technology producer. This is encouraging for countries aiming for producing technology in wind power. Currently, Turkey has 796 MW of installed wind power. After a rough estimation using the average number of jobs per MW for Europe, if Turkey were to reach 20000 MW of installed wind power, it is possible to create 38,200 jobs. With jobs from related and supporting industries, this number can reach to a number between 50,000 and 60,000. This is an important opportunity for Turkey considering the current alarming unemployment rate. There are also quite a number of unemployed college graduates with necessary degrees to support wind power industry.

Turkey has potential in terms of human resources. However, this potential needs to turn into actual capacity.

Table 2. Average Number of Jobs per MW for European Countries with an Installed Wind Power Capacity over 2000 MW – Based on 2007 Figures

Country	Installed wind power capacity (MW) – end of 2007	Number of jobs directly related – in 2007	The average number of jobs per MW (jobs/MW) – in 2007
Germany	22247	38000	1,71
Spain	15131	20500	1,35
Denmark	3125	23500	7,52
Italy	2726	2500	0,92
France	2454	7000	2,85
United Kingdom	2406	4000	1,66
Portugal	2150	800	0,37

4.2. Knowledge Resources

Societies and associations, universities and research institutions, consultancy firms are among the major knowledge resources. Major societies and associations operating to support various aspects of Turkish wind power industry are:

- EUROSOLAR Turkey, Turkish Section of The European Association for Renewable Energies (EUROSOLAR) (www.eurosolar.org.tr)
- Turkish Wind Energy Association (www.ruzgarenerjisibirligi.org.tr/)
- Wind Power and Hydropower Plants Businessman's Association (RESSIAD - www.ressiad.org.tr)
- Chamber of Mechanical Engineers (www.mmo.org.tr)
- Union of Turkish Engineers and Architects Chamber (www.tmmob.org.tr)
- Wind Energy Power Stations Investors Association (RESYAD)

There are a number of universities and research institutions focused on researching various areas of wind power and industry:

- Marmara University – New Technologies Research and Application Center (www.ytam.marmara.edu.tr/)
- Gebze Institute of Technology (www.gyte.edu.tr)
- İzmir Institute of Technology (www.iyte.edu.tr)

Buying services from consultancy firms is another way of acquiring necessary knowledge in a broad range of areas. The quality of services may vary. But it is the quickest way of buying expertise at a given price. Currently, there is a limited number of small consultancy firms in Turkey.

To our knowledge, there are no graduate or undergraduate programs focusing on renewable energies and especially wind power. Furthermore, there are no national scientific journals. The literature in Turkish is quite limited. Nevertheless, there are national conferences and symposiums focused on renewable energies and wind power

Standards are important knowledge sources. Experts create standards ideally with the support of the industry. Therefore, standards incorporate expertise, technical knowledge, and guidance. Naturally, national standards aim to serve the national industry. A national standard sets product specifications helping the industry and supporting and relating industries. A set of national standards may help to build momentum for wind power industry. Currently, there are no national standards to support wind power industry.

In Turkey, knowledge resources need to be improved in order to gain competitive advantage.

4.3. Physical Resources

According to one of the authors of this paper, Tanay Sıdkı Uyar, who has completed Turkish Wind Atlas project in 1989 with his team, the wind power potential in Turkey is 150,000 MW [15-22]. This is an update from earlier

estimations. A previous estimation was 83,000 MW by van Wijk and Coelingh [23]. Another estimation was close to this one and it was 88,000 MW by Cihan Dundar from Turkish State Meteorological Service. Ogulata [24] and Hepbasli and Ozgener [25] supported these numbers in their studies. This potential is considerably higher than the potential in many other European countries. Figure 3 shows Turkish Wind Map. Red and yellow regions indicate high potential for wind power. Most of these regions are located along the coastal line. Green areas have only average wind power potential.

Figure 3. Turkish Wind Map (www.eie.gov.tr)

Site selection for wind power investment is an important issue for wind energy industry. Currently, there are more than 10 wind farms in Turkey. These are clustered in the western side of the country. Most of these are in the Aegean region, specifically in Çanakkale and Bozcaada. Turkey is a big country compared to many other European countries and Turkey's coastline is long. Furthermore, the technical wind power potential is high providing a major opportunity to utilize wind power for generating electricity and boosting wind power industry to help economic growth of the country. Recommendations for high return on investment (ROI) sites are Çanakkale, Çesme, Bandırma, and Samandağ.

Table 3. Wind Power Installed - End of 2009 – Top 20 List -Taken from [26]

Position 2009	Country / Region	Total capacity end 2009 [MW]	Added capacity 2009 [MW]	Growth rate 2009 [%]	Position 2008	Total capacity end 2008 [MW]	Total capacity end 2007 [MW]	Total capacity end 2006 [MW]
1	USA	**35.159,0**	9.922,0	39,3	1	25.237,0	16.823,0	11.575,0
2	China	**26.010,0**	13.800,0	113,0	4	12.210,0	5.912,0	2.599,0
3	Germany	**25.777,0**	1.880,0	7,9	2	23.897,0	22.247,4	20.622,0
4	Spain	**19.149,0**	2.460,0	14,7	3	16.689,0	15.145,1	11.630,0
5	India	**10.925,0**	1.338,0	14,0	5	9.587,0	7.850,0	6.270,0
6	Italy	**4.850,0**	1.114,0	29,8	6	3.736,0	2.726,1	2.123,4
7	France	**4.521,0**	1.117,0	32,8	7	3.404,0	2.455,0	1.567,0
8	United Kingdom	**4.092,0**	897,0	28,1	8	3.195,0	2.389,0	1.962,9
9	Portugal	**3.535,0**	673,0	23,5	10	2.862,0	2.130,0	1.716,0
10	Denmark	**3.497,0**	334,0	10,6	9	3.163,0	3.125,0	3.136,0
11	Canada	**3.319,0**	950,0	40,1	11	2.369,0	1.846,0	1.460,0
12	The Netherlands	**2.240,0**	5,0	0,2	12	2.235,0	1.747,0	1.559,0
13	Japan	**2.056,0**	176,0	9,4	13	1.880,0	1.528,0	1.309,0
14	Australia	**1.877,0**	383,0	25,6	14	1.494,0	817,3	817,3
15	Sweden	**1.579,0**	512,0	48,0	16	1.066,9	831,0	571,2
16	Ireland	**1.260,0**	233,0	22,7	15	1.027,0	805,0	746,0
17	Greece	**1.109,0**	119,0	12,0	18	989,7	873,3	757,6
18	Austria	**995,0**	0,0	0,0	17	994,9	981,5	964,5
19	Turkey	**796,5**	463,1	138,9	25	333,4	206,8	64,6
20	Poland	**666,0**	194,0	41,1	19	472,0	276,0	153,0

Table 3 shows the top 20 countries in installed wind power capacity by the end of 2009. Currently, Turkey ranks 19th

in the world. Last year, in 2009, Turkey increased the installed capacity by %172. This is quite encouraging for Turkey. However there is a long way ahead to achieve the goal of 20,000 MW installed capacity by 2023.

4.4. Infrastructure

Generating electricity in utilizing wind farms is only one aspect of the topic. Another important consideration for wind power industry is connecting the generated electricity from wind power to the national grid. Cabling to enable the connection needs to be provided. Currently, there are limitations in cabling. Such limitations may have adverse effects on developing and improving the wind power industry.

Another issue is providing physical security to wind farms, transformer sites and cabling. Natural disasters such as earthquakes, hurricanes, floods etc. may threat the operational safety of the sites.

Wind farms have to be carefully located to avoid interference from and collisions with air traffic. Since wind power is not widely utilized in the country, this is not an issue for the moment. However, it may be a concern for the future.

Transportation of wind turbines and towers to wind farm sites is an issue for concern if Turkey wants to reach the limitations of Turkey's significant technical wind energy potential. These turbines and towers are of big sizes. Transportation of these big items to remote sites will be a dificult and costly task. Land and other modes of transportation to support such transportation needs have to be considered.

Energy demand is constantly increasing for Turkey. Wind power is an important option for supplying this demand. Turkey's technical wind power potential can supply two times the current electricity demand. Electricity has to be used as soon as generated. Storing electricity is quite expensive and not preferable. Therefore, European countries established European Network of Transmission System Operators for Electricity (ENTSOE). As of July 2009, ENTSOE is fully operational and ENTSOE includes 42 transmission systems operators from 34 countries. Currently, Turkey is not connected to ENTSOE and when connected Turkey may supply electricity for other European countries increasing the market for electricity generation from wind power in addition to the national demand. However, Turkey has to rehabilitate the transmission and distribution lines.

As a result, in Turkey, the infrastructure needs to be improved in the path to gain competitive advantage.

4.5. Capital

In the recent years, Turkey has achieved notable economic growth. Banking regulations were strengthened to enable a steady economic growth while making the economy stronger against crises. Turkish financial institutions are now in good shape and in tight control to support a fast growing economy. In addition, Turkish government developed policies that attract foreign investment.

Turkey is a candidate country for European Union. This is an important factor that opens up significant opportunities for many investors. Capital and energy are the basic fuels of the economy. Therefore, investments in the energy sector became quite attractive in the recent years. However, it should be noted that while gaining attraction is important, sustaining that attraction is as equally important. The government should develop policies at all levels guiding the healthy grow in the wind power sector. Furthermore, incentives such as tax reductions would help to gain momentum. The legislative body must support the industry with passing the necessary laws without delay. Regulatory authorities must produce adequate and on the point regulations to help the sector.

While the world was in a financial crisis with many financial institutions in highly developed countries were in trouble, banks and financial institutions in Turkey declared high profits for the year of 2009. Banks in Turkey has a surplus of capital and they are looking for opportunities to support and finance prospective industries. Currently, in Turkey, wind energy sector provides opportunities for investment. However, financial experts specialized in renewable energies and especially in wind power are required.

With the current technology, cost of wind power per MW is between $0.8 to $1.5 million. A rough estimation would show that Turkey would require $16 to $30 billion to achieve 20,000 MW of installed wind power capacity in today's cost. As a rule of thumb, the cost of wind power per MW may be thought as $1 million dollars. It is important to note that setup costs are relatively high for wind energy. However, operation costs are relatively low compared to other energy sectors. The fuel is one of the most important cost items and wind is free.

In terms of capital, Turkey is in a good position to support the wind energy industry.

5. CONCLUSIONS

Turkey, like many other countries, suffers from a significant deficit. A major contributor to this deficit is the big difference in energy supply and consumption. Turkey imports a great deal of energy. This import amounts to %80 of Turkey's energy consumption. This is why wind power energy is important. Because it is a natural resource; it is free; environment friendly. When renewable energy resources adequately utilized, Turkey will be less dependent on other countries to secure adequate energy to fuel her economy. In short, this path leads energy independence for Turkey. However, currently, Turkish government favors policies that support natural gas and nuclear energy. Priorities are given to lignite and coal, petroleum, natural gas, and nuclear energies. A change in priorities or a careful planning, enabling

simultaneous improvement in various energy sectors, is required.

In this paper, we identified and analyzed wind energy issues related to the factor conditions in Porter's diamond model. The issues were investigated under five categories. These categories are human resources, knowledge resources, physical resources, infrastructure, and capital. Our analysis indicate:

1. Human resources: There is potential and Turkey seems promising. It is possible to create approximately 38,000 direct jobs in wind energy sector, if Turkey were to reach the goal of 20,000 MW installed wind power capacity.
2. Knowledge resources: Turkey needs improvement. Creating knowledge resources is not easy and it takes time. Turkey must take precautions, preferably sooner than later.
3. Physical resources: Turkey is lucky and the country has significant technical wind power potential. However, potential stays as potential until it is transformed to capacity.
4. Infrastructure: Turkey has work to do. The infrastructure needs improvement and upgrades. Many issues that fall under this category require short and long term solutions.
5. Capital: Currently, Turkey is in an advantageous position. Financial institutions and banks are looking for sectors to support. Turkey would require $16 to $30 billion in today's cost to achieve 20,000 MW of installed wind power capacity. Wind energy sector becomes a promising candidate for investment if the sector is supported with necessary policies, regulations, incentives, and legislations.

Overall, in Turkey, factor conditions to gain competitive advantage in wind power industry looks promising. However, it should be noted that there is work to do in the path to achieve the official goal of 20,000MW installed capacity by 2023.

Factor conditions are only one of the determinants in the model. If Turkey wants to gain competitive advantage in wind power industry, Turkey must achieve advantages in other determinants as well. Future work includes an in-depth analysis of other determinants in Porter's diamond model. Finally, an overall assessment of competitive advantage of wind power industry will be conducted.

6. ACKNOWLEDGMENTS

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