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WIND POWER BUSINESS IN THE MIDDLE EAST AND NORTH AFRICA

Market Analysis through Supply Chain and Marketing Perspectives

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FOREWORD

Firstly, thanks God almighty for supporting me through all my life. Then I would like to thank my thesis Supervisor, Professor Petri Helo for his time and support which I cannot describe with words. I have personally learned a lot through the endeavor. I believe that our mission in life is to live in peace and harmony while as we develop innovations for making our lives easier without harming our environment. Renewable energy is the key for green future.

I would like to thank my family members for supporting and believing in me; I would not have achieved any of this without their support. I would like to thank my friends and all Industrial Management group staff at university of Vaasa for their help and knowledge. I would like to thank Finland as a great country for offering this opportunity to develop my skills and to deepen my international life experiences and work experiences.

Finally, I would like to express my special thanks to my dearest parents for making it possible to be where I am now but the true dedication should go to the Syrian revolution and its martyrs who taught us the true meaning of dignity and ambition. They were the real motivation for me to go ahead in my life and feel the need to improve myself, to prove that our youth can go beyond the barriers and restrictions, and to share a very small part of the success with those brave people who gave it all to our country.

Marhaf Kharat Halou

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ABBREVIATIONS

AD	**After Death**
AWEA	**American Wind Energy Association**
BC	**Before Christ**
CanWEA	**Canadian Wind Energy Association**
CDM	**Clean Development Mechanisms**
CDER	**Moroccan Center for Renewable Energy Development**
CEO	**Chief Executive Officer**
CIA	**Central Intelligence Agency**
CO2	**Carbon Dioxide**
CREIA	**Chinese Renewable Energy Industry Association**
EIA	**U.S. Energy Information Administration**
EIB	**European Investment Bank**
EU	**European Union**
EWEA	**European Wind Energy Association**
GCC	**Gulf Cooperation Council**
GRP	**Glass-Reinforced Plastics**
GTZ	**German Office for Technical Cooperation**
GW	**Gigawatt**
GWEC	**Global Wind Energy Council**
IEA	**International Energy Agency**
KSA	**Kingdom of Saudi Arabia**
KWh	**kilowatt-hour**
MENA	**Middle East and North Africa Region**
MW	**Megawatt**

NREA	**New and Renewable Energy Authority**
O&M	**Operation and maintenance**
OECD	**Organization for Economic Co-operation and Development**
ONE	**National Office of Electricity in Morocco**
OPEC	**Organization of Petroleum Exporting Countries**
PPA	**Power Purchase Agreement**
SUNA	**Iran Renewable Energy Organization**
SUNIR	**Iran Power & Water Equipment and Services Export Company**
UAE	**United Arab Emirates**
USA	**United State of America**
USD	**United States Dollar**
UK	**United Kingdom**
WWEA	**World Wind Energy Association**

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ABSTRACT

Energy is an essential feature that enables the social-economic development and economic growth for any nation, which explains why renewable energy, like wind power, became an increasingly significant part of many countries' strategies to achieve reductions in greenhouse emissions. In addition, it is a major factor to reduce the dependency on fossil fuels. However, threats of global warming, acid rain, and nuclear accidents have shown the need to transform existing global energy into focus, especially with the growing demand for energy. For several decades, nations have made plans to reduce their economies' dependency on fossil fuels by substituting them with alternative energy resources such as renewable energy sources in order to sustain their economic growth. On the one hand, the Middle East and North Africa are rich in oil and natural gas, but the fact that oil and natural gas reserves are unevenly distributed, divides the regions' countries to major oil exporters and others as importers. On the other hand, the increasing population in those regions put an extra demand on the power sector, which has been growing rapidly. All the previous challenges encouraged a number of governments in the region to think about alternative power resources and to start developing a national plan for renewable energy. The aim of this study is to identify the status of wind power productivity and development issues in the Middle East and North Africa and its futuristic development scope. The analysis process will investigate deeply the wind resources, the policy environment of renewable energy, existing wind farms, markets development, wind power industry and the futuristic plans.

Keywords: Wind Power, Middle East and North Africa, Supply Chain Management.

1. INTRODUCTION

Energy is an essential feature that enables the social-economic development and economic growth for any nation, which explains why renewable energy, like wind power, became an increasingly significant part of many countries' strategies to achieve reductions in greenhouse emissions. In addition, it is a major factor to reduce the dependency on fossil fuels. However, threats of global warming, acid rain, and nuclear accidents have shown the need to transform the existing global energy into focus, especially with the growing demand for energy (He & Chen2009: 2892-2897).

For several decades, nations have made plans to reduce their economies' dependency on fossil fuels by substituting them with alternative energy resources such as renewable energy sources in order to sustain their economic growth. In meanwhile, international agreements on reducing carbon dioxide (CO_2) emissions such as Kyoto Protocol, which entered into force on 16 February 2005, were signed. Kyoto Protocol objectives imply a 5 % reduction of greenhouse gas emission to the EU (corresponding to about 600 million tons per year CO_2 equivalent) between 2008 and 2012. It means that there will be a need for 250 MW wind turbines per year during this period, if it will be compensated by wind power. According to the European Wind Energy Association (EWEA) and European Commission (2009:157), wind power turbines might be installed in the European Union countries up to 10 to 15 % of the total EU electricity demand. Worldwide, wind energy also supplies a sizable amount of electricity, which will be approximately 16% by 2020 (Blanco 2009: 1372-1382).

1.1. Background Information about the Study

According to the International Energy Agency (IEA), Middle East region is consisting of the following countries: Iran, Iraq, Israel, Hashemite Kingdom of Jordan, Lebanon, Syria, Kuwait, Oman, Qatar, Kingdom of Saudi Arabia (KSA), United Arab Emirates (UAE), Kingdom of Bahrain and Yemen. This region is rich in oil and natural gas, but the fact of the oil and natural gas reserves are unevenly distributed divides the countries region to major oil exporters and others are importers. On other hand, the increased prosperity in the major exporter's countries and the increasing population in the Middle East region put an extra demand on power sector, which has been growing rapidly. In meanwhile, some of the wealthiest countries in the Middle East region are among the world's most carbon intense economies. All the previous challenges encouraged number of governments in the Middle East to think about alternative power resources and begin to developing a national plan for renewable energy. For example, Jordan sets a target of achieving 7% of its primary energy demand from renewable resources by 2015 and 10% by 2020. This demand will include 1.2 GW of wind energy and 600 MW of solar energy. The capital of UAE, Abu Dhabi, committed to secure 7% of its energy need by using renewable resources. This represents almost 1.5 GW of green energy. Kuwait is planning to transfer 5% of its energy demand to a green energy by 2020 (Pullen, Sawyer, Teske & Jones 2010).

The Sahara desert separates The North African region from the rest of the African continent. This region includes the following seven countries: Egypt, Libya, Tunisia, Algeria, Kingdom of Morocco, Sudan and Western Sahara. This region is facing the same challenges that Middle East region is facing regarding the power demand, but wind resources and average wind speeds are ranking amongst the highest globally. Wind resources and average wind speeds are the essential reasons illustrating why 95% of the African wind power capacities were installed in Egypt, Tunisia and Morocco. Furthermore, interesting prospects for wind power in this region is the geographical location that overlooks the Mediterranean Sea and the ability to connect Europe with North Africa by wind and solar power. All of the previous challenges and potentials encouraged a number of governments in this region to adopt an ambitious renewable energy plans and targets for the near future. The Egyptian government is a clear example that sets a target of 20% as a share of its electrical demand operated by renewable energy until 2020. The wind power is expected to contribute 12% of the renewable energy and leave 8% operated by solar energy and hydro power. Morocco has set a target of 18% of its electrical demand operated by renewable energy until 2012 (World Wind Energy Association 2011).

According to future forecasts in the Middle East and North Africa, there will be an increase demand on the power generation sector, expected to be doubled within a decade in these Regions. Therefore, countries in the regions such as Saudi Arabia, the UAE, Egypt and Iraq are planning to invest around 100 billion USD towards the power generation sector. In meanwhile, other 60 billion USD will be invested towards power transmission and distribution in the next 10 years, these indicators are pointing to a vast changes in power generation sector at these regions. In addition, investments in renewable energy sector are expected to grow rapidly as a result of many countries strategies and polices. These strategies aim at reducing traditional fuels usage to generate electricity and manage carbon emissions. This will lead to a high increase in the contribution of renewables in the future at these regions (Alnasera & Alnaser 2011).

Globally, the wind power industry has been growing rapidly at the staggering rate of nearly 30% per year for the last 10-years. A large ratio of this development is occurring in Europe, North America, and Asia markets. This worldwide success has put exceptional pressure on the manufacturers of wind turbine components such as towers, rotor blades, gearboxes, bearings, and generators. In general, wind turbine components are large and heavy. However, the production process is complex and it needs a long term of production cycle, reflected clearly on the supply chain processes.

Finally, one of the most essential benefits of using wind energy is that it reduces the exposure of countries economics to fuel price volatility, even if wind power is more expansive than other form of renewable power generation. This risk reduction from wind power is presently not accounted by using the standard methods when wind power experts calculate the costs of energy. However, wind power is considered as long-term investment if public authorities calculate the energy costs by taking risk reduction costs in their account (Azau 2010).

Here are the essential reasons for considering wind power as alternative green power resource:

1- Wind power reduces air pollution.
2- Wind power is clean, free and indigenous.
3- Wind power combats climate change.
4- Wind power provides energy security.
5- Wind power diversifies energy supply.
6- Wind power eliminates imported fuels.
7- Wind power prevents conflict over natural resources.
8- Wind power hedges prices volatility of fossil fuels.
9- Wind power delivers power on a large scale.
10- Wind power is modular and quick to install.
11- Wind power creates new vacancies, regional growth and innovation (Pullen & Eneland 2006).

1.2. Purpose and objective of the study

Global wind power markets have grown tremendously in the past decade; these markets have been for the past several years dominated by three major markets. Europe (EU27), North America (USA) and Asia (China and India), who were the major three dominating markets. However, the rapid increase of population in these regions, and the decrease in dependency on traditional power resources such as fossil fuel, as well as the high risk of greenhouse emissions in the region have inserted high needs on the governments in the regions to substitute the traditional power resources to renewable energy resources (Pullen at al. 2010).

Inside the study field of renewable energy, many researches have been done concerning the wind power market leaders and the development process of these major markets. Yet, a limited number of studies has been explored the development process of wind power in the emerging markets.

This research study attempts to analyze wind power business in the Middle East and North Africa and illustrate the development process of wind power sector in these regions. The focus will be on the main markets in these regions by analyzing them according to supply chain and marketing perspectives.

This study thereby looks for answers of the following questions:

- What is the current situation and scope of the wind power business in Middle and North Africa regions?
- What is the scope of futuristic development of the wind power business in the Middle East and North Africa Regions?

The objective of the study is to identify the scope of wind power business in Middle East and North Africa regions by analyzing different main markets in these regions and investigating deeply in the following underlying streams:

1- The wind resources (Wind Atlas) and average wind speeds.
2- The policy environment of wind energy and national renewable energy plans with targets.
3- The existing wind farms in Middle East and North Africa regions and market developments in the current time.
4- The current situation of wind power industry and its futuristic development plans in these regions.
5- The futuristic development projects and plans of wind power in Middle East and North Africa regions.

In my study, the empirical data will be gathered from the following sources:

i) International wind research centers reports.
ii) Academic articles and journals.
iii) Official websites of wind turbine manufacturers.

1.3 Research Structure

The research will be divided into six chapters as follows:

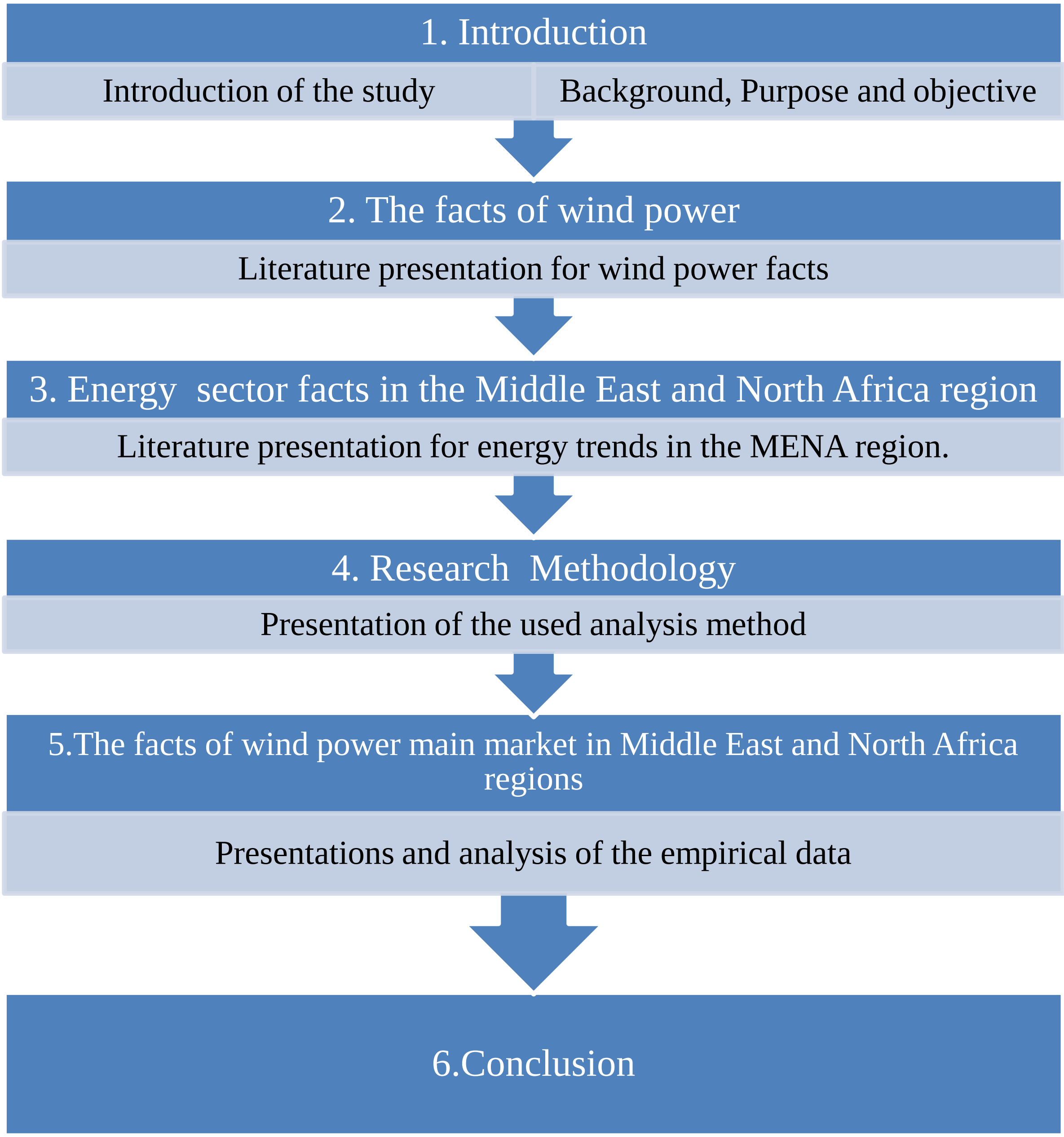

Figure 1. Structure of the thesis

1.3. Research Methods

We can define a research as a process of finding out information and investigation of the unknown to solve a problem or a task. There are different types of research methods, and the aim of these methods is to collect data and to analyze it logically to approach an appropriate findings.

After I have identified research questions, I find that there is a need to establish a plan, describing how data have been collected and analyzed in order to answer those research questions. In general, every project follows roughly the same following process:

1- Define a research topic and research questions.
2- Design the research.
3- Prepare the research by collecting the data and analyzing them.
4- Describe the research by interpreting and reporting the findings.

However, in this research study I will follow a scientific approach to develop a complete research plan before I start collecting the needed data that allows me to decide exactly which type of data I want to collect to reach the suitable findings (Maylor & Blackmon 2005).

This study has been carried out between May 2011 and April 2012. The theoretical part of the study is based on renewable energy field, especially wind power. The theoretical part will be presented in two chapters; the second chapter will describe thoroughly the main principles of wind power technology and its facts, while the third chapter will give a glance about energy sector facts in the Middle East and North Africa regions.

However, a qualitative research methodology will be used to analyze the research question. The empirical part of the study will be based on archive data, which will be collected from reports, academic articles, and official websites of wind turbine manufacturers. Data collection technique will be based on multiple sources of data to identify the scope of wind power business in Middle East and North Africa regions by analyzing different main markets in these regions according to supply chain and marketing perspectives (Baxter & Jack 2008).

2. THE FACTS OF WIND POWER

This chapter introduces a literature glance about the following wind power facts:

1- Wind power history.
2- The status of global wind power market.
3- Wind turbine-manufacturing trends.
4- Wind power supply chain.
5- The Logistics of wind industry.

2.1. A Glance about wind power history

Wind power is not a new invention. For several decades, humankinds have been using windmills and watermills as sources of power to drive a number of mechanical applications. These windmills mainly were used to ground grains and for irrigation or drainage. However, the appearance of the simplest wind devices goes back to thousands years when vertical axis windmills found at the Persian- Afghan borders around 200 BC. After a long time between 1300 and 1875 AD, the horizontal axis windmills appeared in Netherlands and around the Mediterranean Sea zone. Real development and improvement of these systems appeared in the USA during the 19th century. The revelation proved by using over 6 million of these systems for water pumping between 1850 and 1970.

In 1888, first wind turbine, used for generating electricity with 12 KW as capacity was installed in Cleveland, Ohio. In meanwhile, the use of 25 KW turbines in Denmark during the last stage of World War I was widespread. In the period between 1935 and 1970, the great efforts in Denmark, Germany, UK and France proved that large-scale wind turbines could be used. After World War II, the European efforts continued in developing the large scale of wind turbines that was seen clearly in Denmark when the Gedesr mill 200 KW with three-bladed upwind rotors wind turbine operated successfully until the early 1960s. However, further series of advanced horizontal-axis designs were developed in Germany until the 70s.

In 1973, the oil crises has a positive effect on the United State government's decisions related to the increase of the efforts and involvements in wind energy research and development sector. These efforts are considered as the essential backbone in the near history of wind energy developments. From 1973 to 1986 new concept of the commercial wind turbine market developed from agricultural and domestic to utility interconnected wind farm applications. As result of this new concept was the first wind large scale farm penetration in California where over 16000 wind turbines ranging from 20 to 350 KW were installed between 1981 and 1990 to achieve a 1,7 GW as total capacity. After 1990 most of the market development and activities shifted to Europe, which can be considered as one of main market leaders with other regions in the last twenty years (Kaldellis & Zafirakis 2011).

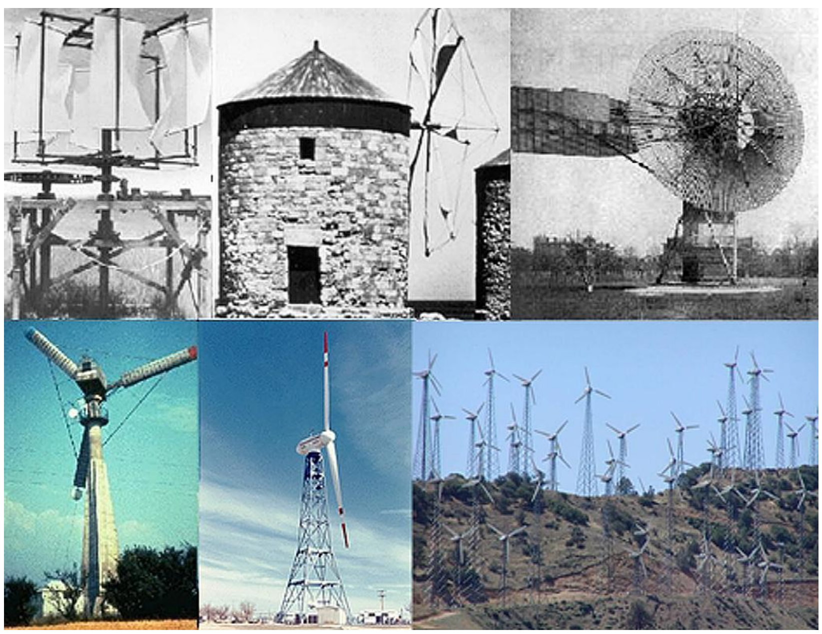

Figure 2. Pictures for windmills from the early stages of wind energy exploitation to the outbreak of California (Available at: http://www.telosnet.com)

2.2. The current status of global wind power market

In 2009, global wind power industry continued to expand rapidly despite the economic recession. It produced 35 % of the annual new installed growth rate. Adding 38.106 GW as new installed capacity increased the global wind power capacity during 2009 to produce 160,084 GW as cumulative installed capacity.

Year	Installed MW	Increase %	Cumulative MW	Increase %
2004	8154	-	47912	-
2005	11542	42%	59399	24%
2006	15016	30%	74306	25%
2004	19791	32%	94005	27%
2008	28190	42%	122158	30%
2009	38103	35%	160084	31%
Average growth-5 years		***36.1%***		***27.3%***

Table 1. World Market Growth Rates 2004-2009 (BTM Consult ApS – March 2010)

The European Union, USA, and Asia dominate global wind power development. However, in 2009 the Chinese market stands first globally in newly installed capacity markets. By the end of 2009, the European market came first by producing 48.2 % of the total global new installed capacity. The Asian Market led by China and India came second with 24,6% of the total global new installed capacity, and the North American market came the third by producing 24.4% of the total global new installed capacity. The Pacific region produced 1.4% % of the total global new installed capacity. The Latin America and Caribbean market produced 0.8% of the total global new installed capacity. Finally, the Middle East and Africa market was ranked in the last place with 0.5% of the total global new installed capacity (Junfeng, Pengfei & Hu 2010).

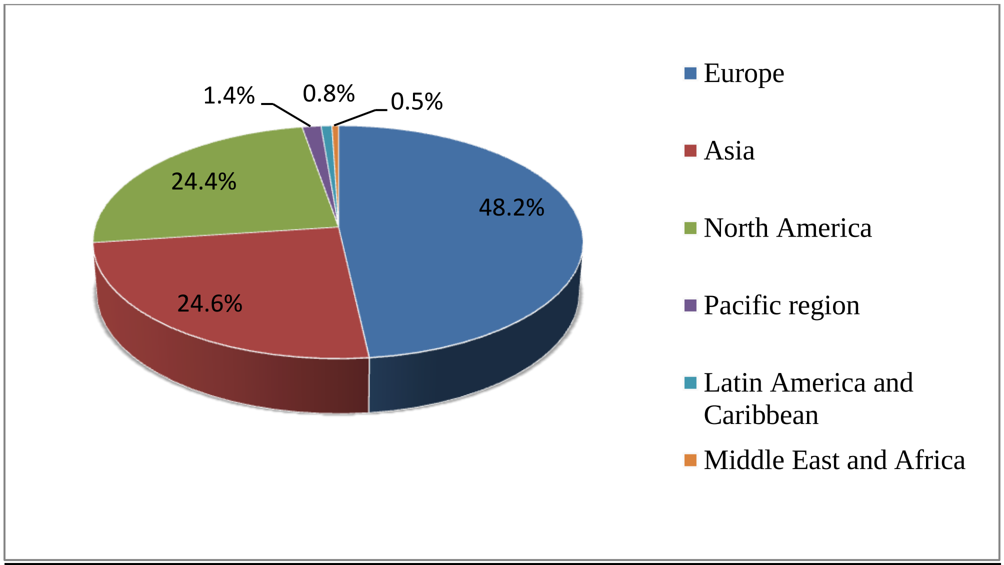

Figure 3. Regional distribution of wind power capacity installed in 2009 (BTM)

In 2010, the ongoing economic recession had its effect on wind power industry, which showed the low level of orders, seen during this year. It achieved just a 3% of the annual new installed growth rate. The European market new installed capacity was 75 %; less than of what their number in 2009. The US market new installed capacity decreased 50% down in 2009. However, the cumulative installed capacity increased by 25% during 2010 and the main market leaders continuing to be Asia, Europe and USA, but the emerging markets in Latin America are beginning to take off, led by Brazil and Mexico.

For the first time in 2010, the Chinese market claim to the first spot globally in terms of cumulative installed capacity, which counted 50% of the global new installation capacity.

Year	Installed MW	Increase %	Cumulative MW	Increase %
2005	11542		59399	
2006	15016	30%	74306	25%
2007	19791	32%	94005	27%
2008	28190	42%	122158	30%

2009	38103	35%	160084	31%
2010	39404	3%	199520	25%
Average growth- 5 years		***27.8%***		***27.4%***

Table 2. World Market Growth rates 2005-2010 (BTM Consult – A Part of Navigant Consulting – March 2011)

By the end of 2010, the Asian market led by China produced 55.5% of the total global new installed capacity, the European market came in the second place with 25.67% of the total global new installed capacity. The North American market, which includes USA and Canada, came the third with 15.025%. The Latin America and Caribbean market was growing rapidly with 1.82% of the total global new installed capacity. Africa and Middle East market produced 0.55 % of the total global new installed capacity. The new installed capacity of this market is located in the North African countries. Finally, the Pacific region came last with 0.455% of the total global new installed capacity (Pullen & Sawyer 2011).

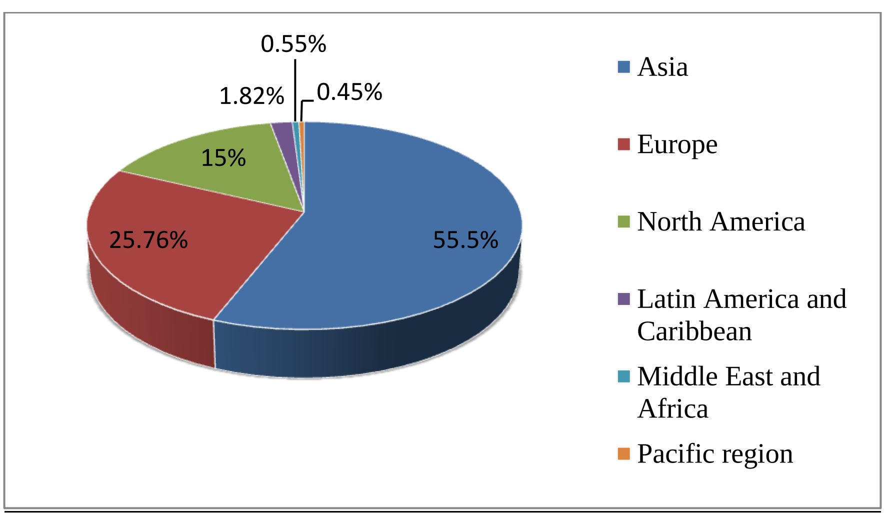

Figure 4. Regional distribution of wind power capacity installed in 2010 (BTM)

In the first half of 2011, global wind industry saw a sound revival after a weak year in 2010. Concerning The World Energy Association (WWEA), 18.405 GW added to the global cumulative wind capacity to reach 215 GW by the end of June 2011. This increase represents 15% more than in the first half of 2010. When only 16 GW were added. It was expect that the global cumulative wind capacity would reach 240.5 GW by the end of 2011.

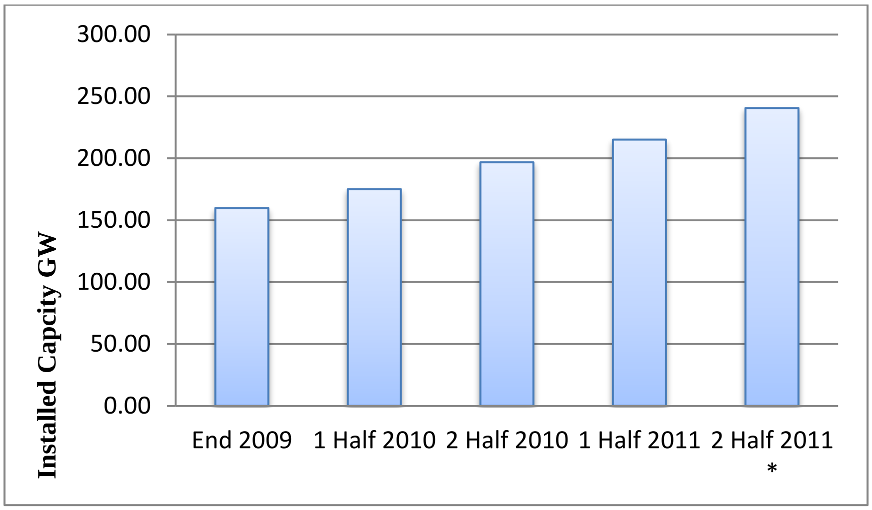

Figure 5. Total installed capacity 2010-2011 [GW] (WWEA .2011)

When it came to the main market leaders in 2011, China continued dominating the global wind market by adding 8 GW and reaching 52.8 GW as a cumulative wind capacity in the first half of 2011. However, China new installed capacity in the first half of 2011counted 43% of the global new installed capacity and compared with 50% in the full year of 2010. Most of the European markets showed stronger growth in 2011 than that of the previous year. Germany was still the leader by adding 776 MW and reaching 27.981 MW as total installed capacity. Spain came second with 484 MW of the new installed capacity that reached 21.150 GW as total capacity. Italy came third with 460 MW of the new installed capacity that reached 6.2 GW of total installed capacity. France showed a decrease in the new installed capacity with 400 MW that reached 6.06GW of the total installed in the first half of 2011. The United Kingdom stepped up to 504 MW of the new installed capacity that reached 5.707 MW of the total installed capacity. Recently Portugal was among the top ten of markets leaders with 260 MW of the new installed capacity that reached 3.96 GW of total capacity. Surprisingly Denmark is out of the top ten markets leaders list. In meanwhile, the US market was able to add 2.252 GW as new installed capacity to reach 42.432 GW by the end of June 2011 also the Canadian market is growing rapidly by installing 603 MW at the first half of 2011.

Position	Country	Total Capacity by June 2011 [MW]	Added Capacity first half 2011 [MW]	Total Capacity end 2010 [MW]	Added Capacity first half 2010 [MW]	Total Capacity end 2009 [MW]
1	China	52800	8000	44733	7800	25810
2	USA	42432	2252	40180	1200	35159
3	Germany	27981	766	27215	660	25777
4	Spain	21150	480	20676	400	19149
5	India	14550	1480	13065	1200	11807
6	Italy	6200	460	5797	450	4850
7	France	6060	400	5660	500	4574
8	United Kingdom	5707	504	5203	500	4092
9	Canada	4611	603	4008	310	3319
10	Portugal	3960	260	3702	230	3357
	Rest of the world	29500	3200	26441	2750	21872
	Total	***215000***	***18405***	***196682***	***16000***	***159766***

Table 3. Top ten markets leader list from 2009 – June 2011 (WWEA 2011)

During the first half of 2011, there were new wind markets, arising and three new countries added to the list of countries that are using wind energy. The number of countries, using wind energy increased from 83 to 86 globally. Ethiopia, Venezuela and Honduras are now using wind energy also Dominican Republic just finished installing its first major wind farm. This wind farm capacity increased from 0.2 MW to 60.2 MW. In meanwhile, Eastern

European markets are still bombing and showing high growth rates such as Romania with 10% growth, Poland with 22% growth, Estonia with 32% growth and Croatia with 28% growth.

A number of countries aim to enter the wind power markets by showing ambitious plans and legislation such as Japan, Ecuador, Malaysia and Uganda (WWEA 2011).

By the end of 2011, the global wind market installed totally around 41 GW as new installed capacity according to The Global Wind Energy Council annual market statistics. With this new installed capacity, the global wind power capacity during 2011 increased to produce 238 GW as a cumulative installed capacity at the end of the year. Nowadays, about 75 countries globally have commercial wind power installations and 22 of them already passing the 1 GW level as total installed capacity.

The Chinese market still has consolidated its position as global market leader in the end of 2011, despite the government new requirements and other market challenge. China has produced 62 GW as a cumulative wind power capacity in the end of the year. In meanwhile, the Indian market reached other milestone by adding 3 GW as new installed capacity in the end of 2011. India produced 16 GW as a cumulative wind power capacity in the end of the year. The European markets installed 9,616 GW as new installed capacity. These new increases allowed Europe to supply 6,3% of its electricity demand by producing 93,975 GW as cumulative wind power capacity in the end of the year. The American wind power industry saw a sound revival after a weak year in 2010 with new installations capacity of more than 6,8GW in the end of the 2011. The total installed capacity by the end of 2011 for the American market reached 46.919 GW.

The Canadian market was able to reach other milestone as well by producing 5GW as cumulative capacity by the end of 2011; this total installed capacity illustrates the ambitious targets for wind power development and the stable policy framework in Canada. The Latin America region is still growing by the end of this year. Led by Brazil, The Brazilian new installation capacity were up by half. Producing 587 GW as new installed capacity and reaching 1.5 GW level as cumulative capacity in the end of the year.

Country	New Installed Capacity MW	Market Share %
China	18000	44
USA	6810	17
India	3019	7
Germany	2086	5
UK	1293	3.1
Canada	1267	3.1
Spain	1050	2.5
Italy	950	2.3
France	830	2.0
Sweden	763	1.9
Rest of the World	5168	12.5
Total Top 10	**36068**	**87.5**
World Total	**41236**	**100**

Table 4. Top 10 new installed capacity Jan- Dec 2011 Global wind statistics 2011 report (GWEC)

Country	Cumulative Capacity MW	Market Share %
China	62733	26.3
USA	46919	19.7
Germany	29060	12.2
Spain	21674	9.1
India	16084	6.7
France	6800	2.9
Italy	6747	2.8
UK	6540	2.7
Canada	5265	2.2
Portugal	4083	1.7
Rest of the World	32446	13.6

Total Top 10	**205905**	**86.4**
World Total	**238351**	**100**

Table 5. Top 10 cumulative capacities Dec 2011 (GWEC)

According to Steve Sawyer, GWEC Secretary General, The future forecasts of the global wind power industry for the long terms fundamentals will remain very promising. For the second year, the majority of new installed capacity took place outside the Organization for Economic Co-operation and Development (OECD) zone, while the emerging markets in Latin America, Africa and Asia are still leading the global market growth.

"In the coming years, the Chinese wind power market is expected to continue developing and the industry will grow stronger and adopt more to the government's new requirements", Li Junferng said, Secretary General of the Chinese Renewable Energy Industry Association (CREIA). "However, the Indian wind power market is expected to add 5 GW as new installed capacity per year by 2015 and the government is in progress to create new policies. These new policies are aiming to attract larger quantities of private investments to the Indian wind power sector", commented D.V. Giri, Chairman of the Indian Wind Turbine Manufacturers Association. "In meanwhile, the European Union should adopt an ambitious strategy for installing new wind power capacities in the long-term period to approach the rapid growth rate again in the near future. This new strategy will offer a sold level of new capacity installations to reach the 2030 European target and it will create a strong positive signal to potential investors", said Justin Wilkes, Policy Director of EWEA. After a weak year in 2010, The American wind power industry saw a sound revival in 2011. This bounced back reflects positively on the wind energy's long-term fundamentals targets, which were lunched earlier by the American governments. "Our 2011 installations alone provide enough electricity to power almost two million American homes", said Denise Bode, CEO of the American Wind Energy Association (Fried, Shukla & Sawyer 2012).

As conclusion in 2012, indicators point that new markets in Africa, Latin America and Asia regions are willing to begin operating wind power as renewable energy source. However, “the emerging markets in Latin America are expected to expand rapidly beyond Brazil and Mexico”. Says, Steve Sawyer, GWEC Secretary General.

2.3. A Glance about wind turbine manufacturing trends

The global wide variations in wind power demand encouraged the global wind turbine manufacturing to remain regionally segmented. This regional segmentation depends on the diversity of markets developing speeds and the resource characteristics. Nowadays, the industry is becoming ever more globalized and not monopolized by the European manufacturing pioneers (Pullen, Hays & Knolle 2009).

By the end of 2011, Vestas the Danish manufacturer once again retained its top spot in wind turbine manufacturers by annual deliveries, with deliveries of 5.22 GW. However, the Chinese manufacturer Sinovel came in the second spot with 3.7 GW of deliveries, compared with 4.39 GW in the end of 2010. The other Chinese manufacturer Goldwind came in the third place with 3.6GW as annul deliveries, which it present 8.7 % of the annual market share and compared with 4.39 GW in the end of 2010. Gamesa the Spanish manufacturer came in the fourth position, with turbine deliveries of 3.31 GW in the end of 2011. Gamesa succeed in increasing its global market share from 1.6% in the end of 2010 to reach 8% by in the end of 2011. The German manufacturer Encrcon maintained its fifth place, with turbine deliveries of 3.203 MW. The following table illustrates the top ten wind turbine manufacturers by annual market share and delivered capacity in the end of 2011 (Backwell 2012).

Manufacturer Name	Market Share %	Delivered Capacity MW
Vestas (Denmark)	12.7	5217
Sinovel (China)	9.0	3700
Goldwind (China)	8.7	3600
Gamesa (Spain)	8.0	3308
Enercon (Germany)	7.8	3203

GE Engergy (USA)	7.7	3170
Suzlon Group (India)	7.6	3116
Guodian United Power (China)	7.4	3042
Siemens (Germany)	6.3	2591
Ming Yang (China)	3.6	1500

Table 6. Top 10 wind turbine manufacturers by annual market share and delivered capacity Dec 2011(IHS-EER)

2.4. Global wind turbine supply chain

Supply chain management is considered as a key to wind turbine supply. In general, wind turbine components are large and heavy. However, the production process is complex and it needs a long term of production cycle, reflected clearly on the relationships between turbine manufacturers and their component suppliers. This relationship becomes increasingly crucial due to the rapid increase in global demand at the past seven years .The global increase demand requires larger investments, faster ramp-up times and greater flexibility to capture value in a rapidly growing sector.

In meanwhile, supply chain challenges have dictated product strategies, product capabilities and pricing for every turbine supplier, while turbine manufacturers have designed the most competitive balance strategies between full components net outsourcing and a vertical integration of component supply to fit their turbine designs and production needs. These procurement trends have created a market structure for each component segment, illustrating the complexity of wind turbine design and manufacturing process. Therefore, the fact that the market for multiple segments, like blades, gearboxes and bearings, is highly concentrated, and produces pinch points in the supply chain. These critical segments have high entry barriers based on the manufacturing ramp-up time and the size of the investments. At the same time, generators, castings, towers and controls segments have larger number of suppliers and lower entry barriers. The following figure illustrates an overview on the supply chain process for wind turbine components (Pullen et al. 2009).

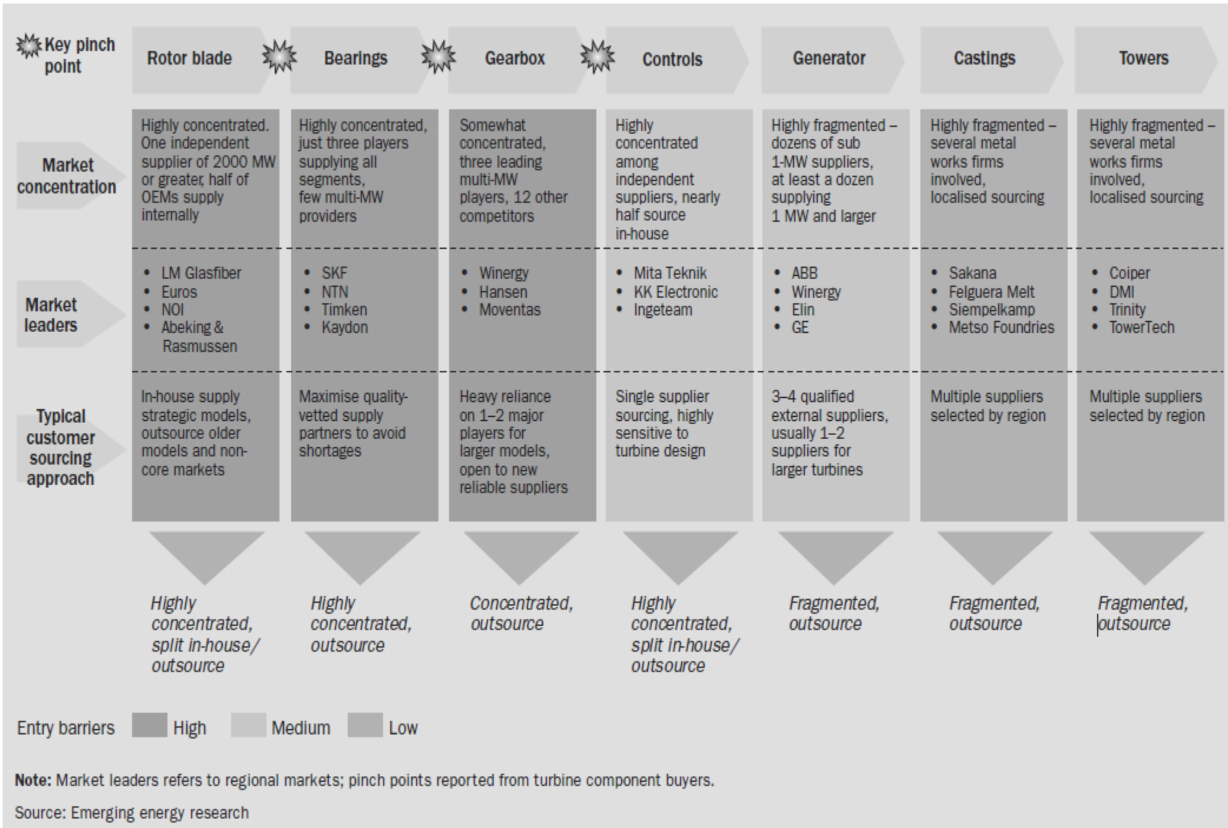

Figure.6 Turbine component supply chain overview (Emerging energy research)

As a conclusion, the supply chain of wind turbines is vertically large compared to other renewable energy applications such as solar energy and biomass. Meanwhile, wind turbine components can be classified into three groups; Components have specific market and technology such gearbox, blades and bearings. The second group is components with specific requirements but no specific technology while the third group is components with no specific market and specific technology. The high level of specificity in the wind supply chain explains the global shortage of gearbox bearings and other components while the trends for international suppliers is to build factories with production lines in labor cheap countries such India and Romania. The following figure illustrates the Wind Turbine Supply Chain Components (Environics 2010).

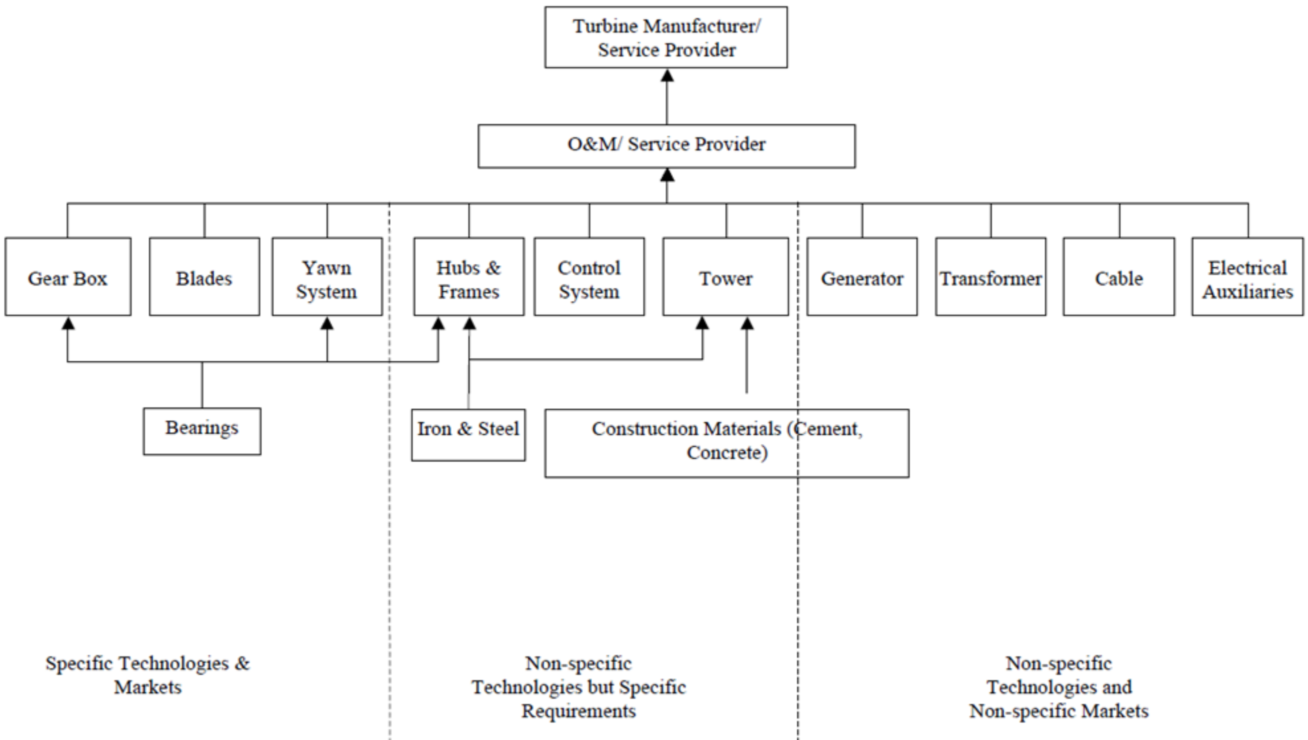

Figure.7 Wind Turbine Supply Chain Components

2.5. Logistics of wind industry

In the last decade, the rapid growth of wind industry contributed in increasing the transportation and logistics challenges that are facing the wind turbine manufacturers and developers. The main challenge shifts the sensitive and heavy components of wind turbine from the factory floor to the project site, which weight several tones and extend over a hundred feet in lengths. Meanwhile, this rapid growth has created new business opportunities for transportation companies and logistics providers.

In order to serve the wind power industry a company must be able to transport oversized/overweight cargo or manufacture equipment capable of doing so. The following are roughly guidelines on the physical dimensions of 1.8 MW wind turbine by the Canadian Wind Energy Association (CanWEA):

- The nacelle is hosting the generator, gearbox, drive train, and brake assembly while it weighs around 63 Ton.
- Each blade is 39 meter long and the blade-rotor weighs around 35 Ton.
- The 65-meter tower is made up of rolled steel and comes in three parts while the entire tower weighs is 132 Ton.
- The foundation concrete is 9 – 10 meter deep and 4 meter across while a 102 tension type bolts run the full depth of the foundation.
- Swept area of the blade is around 5.024 sq. meters.
- The total weight of the entire turbine is 230 Ton.

The previous example illustrates the size of wind turbine and gives estimation on the complexity of the transportation process. However, a single turbine can require up to eight loads (one nacelle, one hub, three blades and three tower parts). According to the American Wind Energy Association (AWEA), the transportation requirements for 150 MW wind farm project have been required 689 truckloads, 140 railcar and 8 vessels to the United States of America while many projects today are much bigger than 150 MW.

In general, the main transportation and logistics challenges that are affecting wind industry can be summarized in the following points:

- The wind turbine components are growing rapidly in terms of size and weights especially, nacelles, blades and towers that may exceed the physical capacity of existing equipment.
- The limited numbers of railcars and truck trailers those are capable of transporting the turbine components.
- The growing costs of logistics and transportation, which can be estimated around 10-25% to the total cost of a turbine.

In addition, individual modes of transport (trucking, rail and water) have their own unique challenges. For trucking, there are variety of challenges that includes states and local permitting rules for oversized/overweight loads, tight carrier capacity and rising fuel costs.

Meanwhile, rail is considered as the most cost-efficient mode of transportation for wind turbines, but the difficulties of accessing the final project sites are the main reasons, limiting the use of rail in some cases especially in transporting blades, which need well-equipped railheads for transferring components to trucks. For water, the key challenge is the time, which takes for ocean travel and the limitation access to final project locations.

All the pervious challenges have emphasized the need to think and consider logistics and transportation issues as key factor for reducing the costs of implementing wind farm projects. According to CN North America's Railroad Company, moving wind turbine components are requiring extensive coordination, communication and scheduling efforts between transportation companies and logistics providers. This complex coordination process is the effective tool to minimize the risks of occurring unpredictable situations especially when moving wind turbines from one continent to other. For instance, each state in the USA has its own laws and permits for shippers in order to move over-sized cargo. In addition, using the rail to transport wind turbines relieves traffic congestion, improves mobility in urban areas and reduces the transportation costs through delivering the cargos faster and more secure than other modes (CN North America's Railroad 2009).

3. ENERGY SECTOR FACTS IN THE MIDDLE EAST AND NORTH AFRICA (MENA)

This chapter introduces a highlight about energy sector facts in the Middle East and North Africa. According to the World Bank, the Middle East and North Africa considered as one region. MENA region is economically a diverse region, which includes both oil and gas rich economies in the Gulf area and countries such as Egypt, Morocco and Yemen, who are resources-scarce comparing to population. This economic fortune has been influenced by two major factors, oil and gas prices and the legacy of the economic policy structures. In 2010, the majority of MENA countries have recovered from the global financial crisis, while the growth rates were expected to reach pre-crisis levels in 2011.

Early in 2011, a series of pro-democracy movements began, which been later known as Arab Spring that resulted in swift regimes change in Tunisia, Egypt, Libya and Yemen and spread to Bahrain and Syria as well. The uncertainties associated to these movements have affected the short-term macroeconomic status and the speed of economic reforms in the MENA region. However, the futuristic forecast for the long-term macroeconomic status depends on the rapid political and economic reforms in MENA region after the Arab Spring (Ianchovichina, Mottaghi, Wood, Loening & Savescu 2011).

3.1. A Glance about liquid fuels production, consumption and crude oil reserves in Middle East and North African region (MENA)

3.1.1. Liquid fuels production in MENA region

By the end of 2010, the total worldwide daily supply of liquid fuels was estimated around 86,3million barrels per day. The Middle Eastern and North African countries supplied around 30 million barrels per day. These 30 million barrels per day represented more than one-third of the estimated total worldwide daily supply. At that time, KSA, Iran and UAE supplied around 20% of the total worldwide daily supply during 2010. Together, Libya and Algeria supplied around 5% of the total worldwide daily supply by producing around four million barrels per day. The following figure illustrates the Middle East and North Africa regions share of global fuel production during 2010.

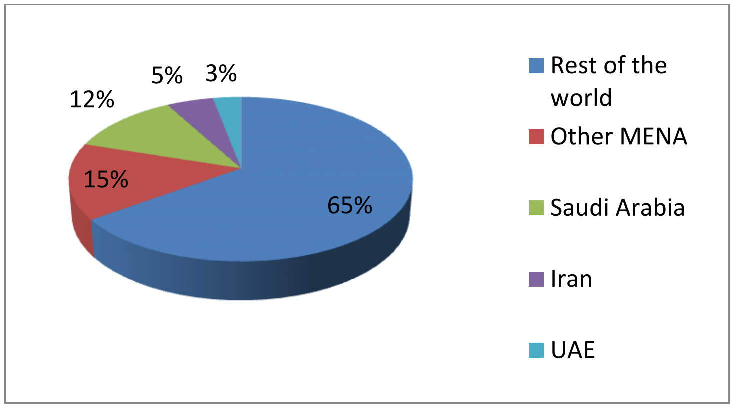

Figure 8. MENA share of global fuel production during 2010 (EIA)

By the end of 2011, the total worldwide daily supply of liquid fuels was estimated around 86,954 million barrels per day. Middle Eastern and North African countries supplied around 30,465 million barrels per day. While Saudi Arabia supplied around 12,8% of the total worldwide daily supply by producing 11,1703 million barrels per day. Iran supplied around 4.8% of the total worldwide daily supply by producing 4,234 million barrels per day. The following figure illustrates the Middle East and North Africa regions share of global fuel production during 2011.

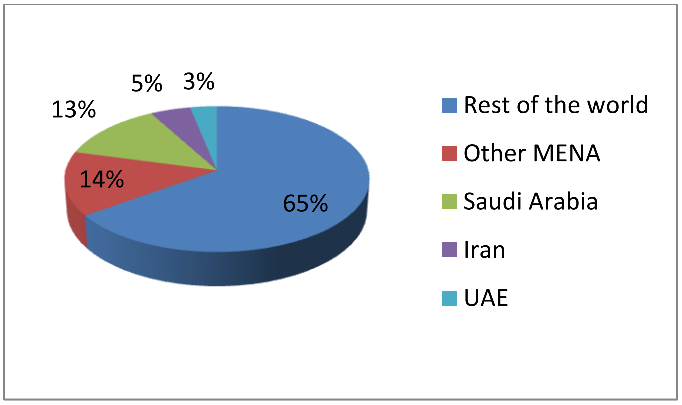

Figure 9. MENA share of global fuel production during 2011 (EIA)

The following table illustrates the total oil supply per day by Middle Eastern and North African countries between 2007 and 2011(U.S. Energy Information Administration 2011).

Country	2007	2008	2009	2010	2011
Algeria	1,967.545	1,954.148	1,909.025	1,879.148	1,884.148
Bahrain	48.43458	48.43458	48.43458	46.43458	47.43458
Egypt	780.3649	718.5459	678.3018	662.6169	681.2416
Iran	4,039.025	4,179.62	4,176.635	4,251.58	4,234.121
Iraq	2,096.636	2,385.578	2,400.339	2,408.465	2,634.582
Israel	4.02907	4.02907	4.02907	4.02907	4.02907
Jordan	0.08777	0.08777	0.08777	0.08777	0.08777
Kuwait	2,603.426	2,728.501	2,496.427	2,450.37	2,681.894
Lebanon	0	0	0	0	0
Libya	1,844.703	1,874.989	1,789.155	1,789.155	495.621
Morocco	3.93794	3.93794	3.93794	3.93794	3.93794
Oman	714.8137	761.1384	816.1527	867.876	888.9089
Qatar	1,121.076	1,203.178	1,212.888	1,437.224	1,637.539
Saudi Arabia	10,248.62	10,783.07	9,759.689	10,521.09	11,170.01
Sudan and South Sudan	466.7621	480.7901	486.4416	514.3183	427.3731
Syria	411.8702	401.1688	399.874	400.9985	333.0757
Tunisia	85.88712	86.76198	91.32411	83.72411	82.58438
United Arab Emirates	2,947.497	3,046.449	2,794.690	2,812.837	3,096.343
Yemen	320.0397	299.6769	286.5042	258.7541	163.0

Table 7. Total Oil Supply by Middle Eastern and North African countries between 2007 and 2011 (Thousand Barrels Per Day)

3.1.2. Oil consumption in MENA region

In 2010, the total worldwide oil consumption was 87.133 million barrels per day and the MENA region is consuming around 8.7% of the total worldwide consumption. Saudi Arabia was the largest oil-consuming country in MENA region, which reached 2.650 million barrels per day. Globally, Saudi Arabia came sixth on the top world oil consuming countries table. The following table illustrates the Top World Oil Consumers in 2010.

Country	Consumption (million per day)
United State of America	19,180
China	9,392

Japan	4,452
India	3,116
Russia	3,038
Saudi Arabia	2,650
Brazil	2,560
Germany	2,495
South Korea	2,251
Canada	2,215
Mexico	2,073
France	1,861
Iran	1,800
United Kingdom	1,622
Italy	1,528

Table 8. Top World Oil Consumers in 2010 (EIA2011)

The following table illustrates the total petroleum consumption per day by Middle Eastern and North African countries between 2007 and 2010.

Country	2007	2008	2009	2010
Algeria	271.09126	296.03742	313	312
Bahrain	43.21912	42.7977	45	47
Egypt	693.53286	720	761	798
Iran	1655.69699	1725	1770	1800
Iraq	570.80792	584.99205	636	694
Israel	241.84452	221.50658	229	238
Jordan	103.5094	96.51505	98	98
Kuwait	321.60551	325.31866	372	354
Lebanon	79.11151	83	82.08368	79.82065
Libya	271.29016	257.66729	264	289
Morocco	183.18371	215.68674	204	209
Oman	90.95882	96	100.15377	106.42992
Qatar	121.5751	123	135.39181	151.67102
Saudi Arabia	2144.44867	2270	2460	2650
Sudan and South Sudan	85.11115	94.19003	92	98
Syria	264.30652	273	268.08056	268.08677
Tunisia	88.43608	91.69036	92	84
United Arab Emirates	477.58296	525	524.57158	546.16968
Yemen	121.01271	157.45852	161	157

Table 9.The total petroleum consumption per day by Middle Eastern and North African countries between 2007 and 2010 (Thousand Barrels Per Day)

3.1.3. Crude oil reserves in MENA region

According to the estimation of the Organization of Petroleum Exporting Countries (OPEC), more than 80% of the proven oil reserves are located in OPEC member countries in the end of 2010. Almost 65% of the total OPEC oil reserves are located in MENA region countries. In meanwhile, OPEC member countries have made significant additions to their oil reserves in recent years by investing heavily in research and development sector and adopting the most develop practices in the industry. As a result, OPEC has proven oil reserves above 1,190 billion barrels while, Non-0PEC countries has around 274 billion barrels as proven oil reserves in the end of 2010. The following figure illustrates the OPEC countries share of world crude oil reserves in the end of 2010 (Organization of the Petroleum Exporting Countries 2010).

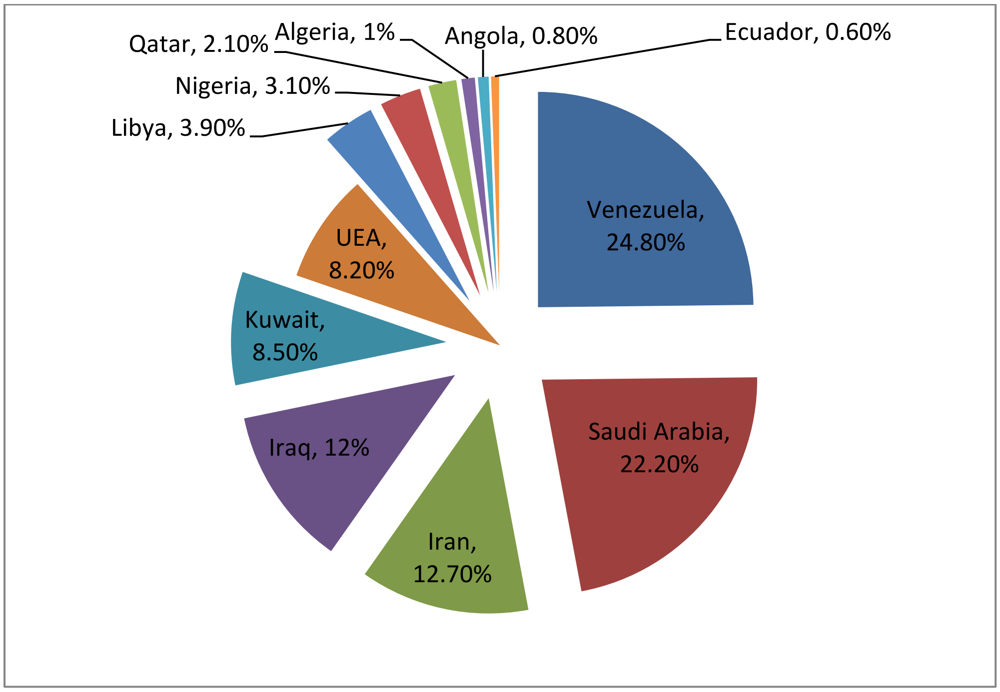

Figure 10. OPEC share of world crude oil reserves in the end of 2010 (OPEC 2011)

3.2. A Glance about natural gas production and reserves in Middle East and North Africa region (MENA)

3.2.1. Natural gas production in MENA region

In the end of 2010, the world natural gas production grows up to 7.3% while the total world production was estimated around 309 Billion cubic feet per day. The MENA region share of the total world natural gas production was around 19.2% while Qatar increased its production share by 30.7% in the end of 2010 comparing to 2009. In meanwhile, Iran supplied around 4.3 % of the total worldwide natural gas production by producing 13.4 Billion cubic feet per day. Qatar supplied around 3.6% of the total worldwide natural gas production by producing 11.3 Billion cubic feet per day.

The following figure illustrates the MENA region share of global natural gas production per day during 2010 (British Petroleum 2011).

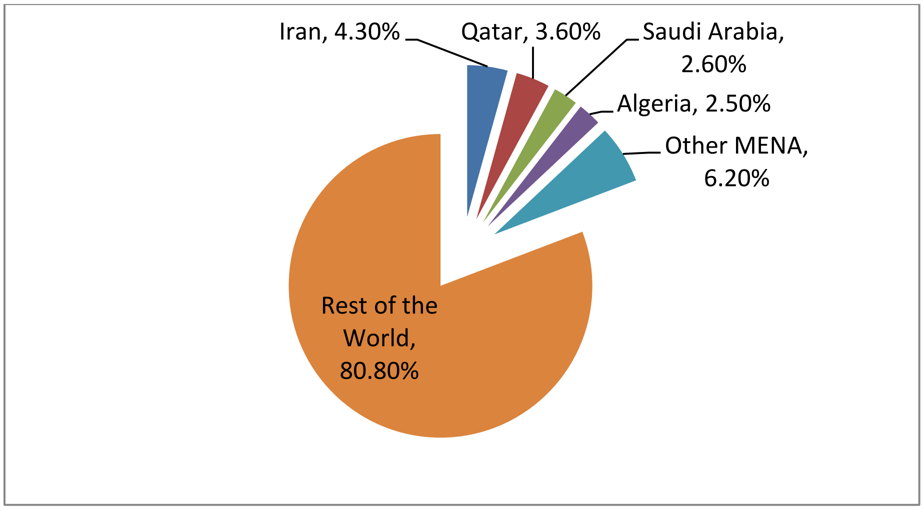

Figure 11. MENA region share of global natural gas production in the end 2010 (Cedigaz)

3.2.2. Natural gas reserves in MENA region

Based on data from British Petroleum (PB) by the end of 2010, the majority of proved gas reserves are located in three main countries: Russia (23.9%), Iran (15.8%) and Qatar (13.5%). The regional distribution shows that Middle East and North Africa region stands at the first spot with 45% as share of the total worldwide natural gas reserves. The total worldwide natural gas reserves reached 187.14 Trillion cubic meters by end of 2010.

The following figure illustrates the regional distribution of proved natural gas reserves in 2010 (British Petroleum 2011).

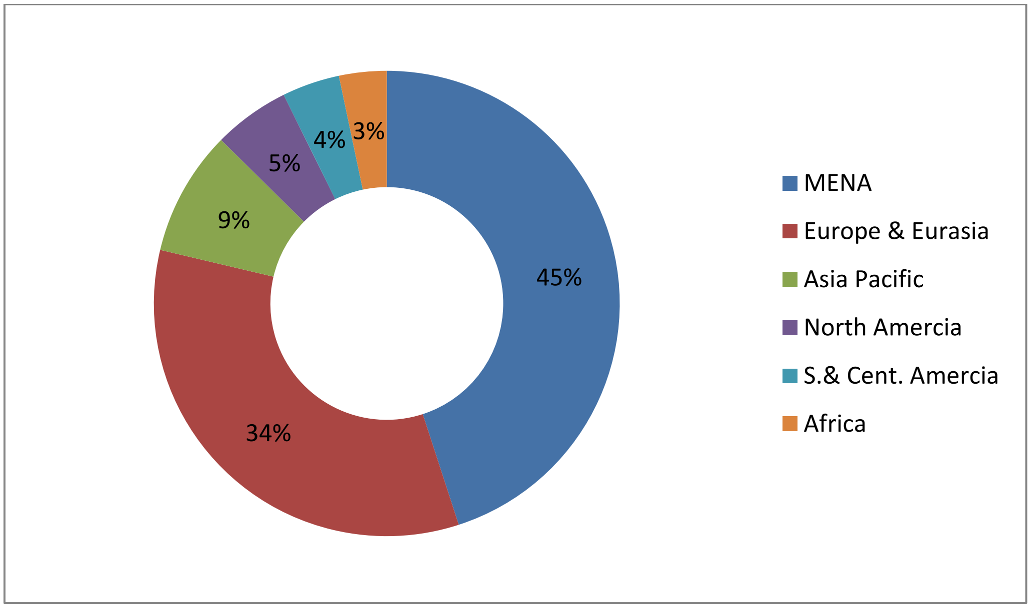

Figure 12. Regional distribution of proved natural gas reserves in 2010 (PB Statistical Review of World Energy)

3.3. A Glance about electricity generation in the Middle Eastern counters

Due to the low prices of oil and natural gas in the Middle Eastern countries, there is a significant reliance on liquid fuel and natural gas to generate most of the region electricity demand. Meanwhile, North African countries are focusing more on renewable energy, especially solar and wind, as alternative energy resources and planning to increase the share of renewable energy to generate electricity, which will be analyzed deeply in the following chapters.

Regarding the reference case of International Energy Outlook 2010, electricity in the Middle East grows to 2.5% per year, from 0.7 trillion KWh in 2007 to 1.3 trillion KWh in 2035. This growth in electricity demand depends on two underlying streams; the first stream is the rapid development growth in infrastructure sector and its investments in the region countries. The second stream is the rapidly growth of population rate along with a strong increase in the national income. United Arab Emirates, Kingdom of Saudi Arabia and Iran account for nearly 75% of the regional demand for electricity. The electrical demands in these specific countries are sharply increased over the past several years, especially between 2000 and 2007. UAE's net electricity generation increased by 9.6% as average per year and Iran's by 7.9 % per year, while Saudi Arabia net electricity generation increased by 6.1% per year. Therefore, there are ambitious plans to increase the other energy sources share to reach the diversity contributions in electricity generation sector in the Middle Eastern countries. The following examples illustrate more the governmental intentions in the Middle Eastern countries to add more diversity of its electricity generation sector:

- In 2006, Abu Dhabi government established Masdar, which is a commercially driven enterprise. The main propose of establishing Masdar is to reach the wide boundaries of the renewable energy and sustainable technologies industry in UAE. Masdar City is one of the company units, which meant to be as an emerging global clean-technology cluster with zero carbon emissions. 190 MW of PV cells and 20 MW of wind power will power the city, while the constructing period should be completed in 2016. Finally, the city has Masdar Institute that is developed in cooperation with the Massachusetts Institute of Technology and the city has been chosen as headquarter for the International Renewable Energy Agency (IRENA).
- In 2007, the Gulf Cooperation Council countries (Kingdom of Saudi Arabia, State of Kuwait, Kingdom of Bahrain, United Arab Emirates, State of Qatar, and the

Sultanate of Oman) completed a feasibility study on the potential possibilities for a regional nuclear power and desalinization program at the Arabic gulf region. This study was in cooperation with the International Atomic Energy Agency.

- In 2008, Oman announced its plan for constructing the first Arabian Gulf coal-fired power plant at Duqm. This 1-GW plant supposed to provide a power for water desalinization facility and it is expected to be fully operational by 2016.
- In 2008, The United Arab Emirates government announced its plans for constructing three nuclear power plants with 1.5 GW as total capacity. These power plans should be completed by 2020. Meanwhile, the UAE government signed nuclear cooperation agreements with Japan, France, the United Kingdom and the United State of America.
- In 2009, the Jordanian government announced its intentions to add a nuclear power capacity while, the Kuwaiti cabinet issued a decree regarding a national committee form on nuclear energy use for peaceful purposes (Alnasera et al. 2011).

According to the CIA World Fact Book in 2009, the Gulf Cooperation Council countries (GCC) are producing electrical power and consuming electricity at very high rates. These high rates are clearly showed when Saudi Arabia came in the 16 worldwide position as the most electrical consuming nation with 156.800 GWh. United Arab Emirates came in the 41 place with 57.880 GWh while ,Kuwait came in the 53 place with 39.540 GWh. Qatar was the 76th with 13.190 GWh. Finally, Oman came in the 80 place with 11.190 GWh and Bahrain was ranked as number 88 electricity-consuming countries in the world with 8742 GWh.

Finally, according to the reference case of International Energy Outlook (2011), in the Middle Eastern countries natural gas had supplied around 57% of electricity generation while liquid fuel supplied around 35% and the other 8% by different power resources during 2007. The following figure Illustrates the electricity generation in the Middle East region between 2007 and 2035 in Trillion kWh.

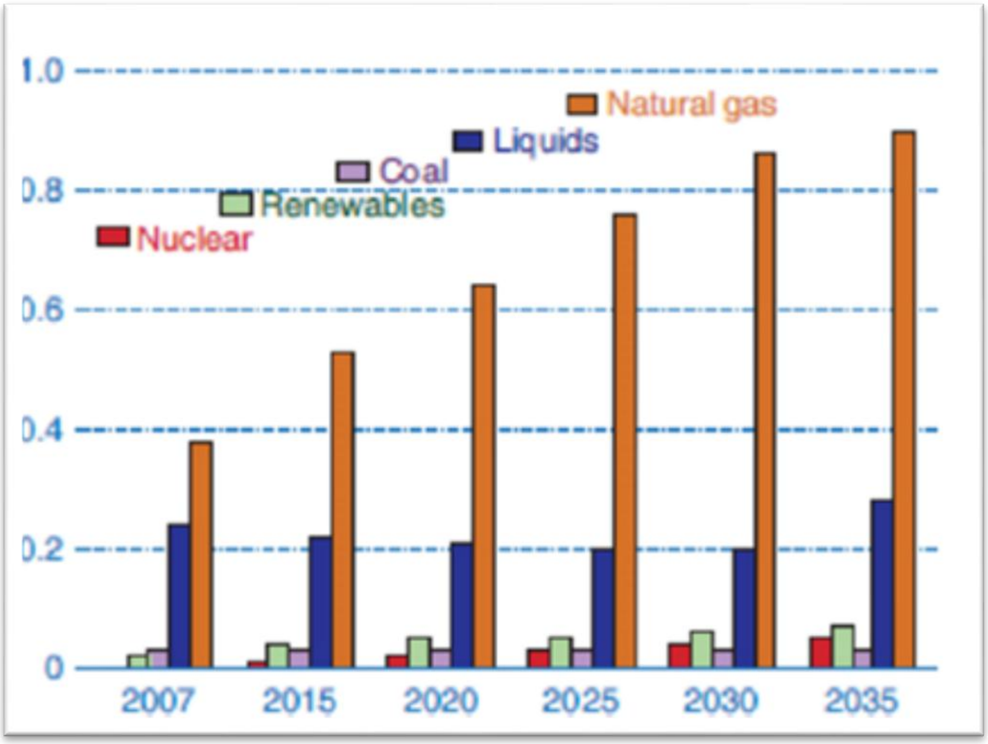

Figure 13. Electricity generation in the Middle East region between 2007 and 2035 in Trillion kWh. (IEO2010)

4. RESEARCH METHODOLOGY

This chapter introduces a glance about qualitative research method and data collection process, which was used in this study to provide compact, but comprehensive results.

4.1. A Glance about qualitative research method

We can define qualitative research as a scientific research, which consists of an investigation that seeks answers for questions, collects evidence, produces findings that were not determined in advance, and creates findings that are not applicable beyond the immediate boundaries of the study. Additionally, it provides variety ways of collecting data and higher flexibility than quantitative methods.

Practically, qualitative research strength is the ability of identifying intangible factors such as; socioeconomic status, market research, social norms, gender roles, religion and ethnicity whose role in the research issue may not be readily apparent. Moreover, it has the ability to provide complex and comprehensive textual description of how people experience a given research issue by providing the human side of an issue.

The main purpose of adopting qualitative research for this study is the ability of these methods to explore phenomena from different aspects rather than seeking to confirm hypotheses about phenomena. The key difference between quantitative and qualitative method is their flexibility. Generally, quantitative methods are inflexible comparing to qualitative methods. Quantitative methods depends on questionnaires and surveys that lead to fixed answers, based on close-ended questions format, while qualitative methods mostly asking open–ended questions which provides more flexibility for researchers and study participants. The objective of this study is to identify the scope of wind power business in Middle East and North Africa regions by analyzing different main markets in these regions and investigating deeply in wind resources, renewable energy policies, existing wind farms, markets developments, wind power industry and the futuristic plans.

This study is an exploratory research that is why adopting qualitative research methodology is more appropriate, and allows the researcher to deliver comprehensive results (Mack, Woodsong, MacQueen, Guest & Namey 2005).

4.2. A Glance on data collection method

According to Yin (1994), presenting high quality and authentic data depends on using different types of sources, which allow the researcher to analysis deeply and conclude the research in widely acceptable way. Practically, qualitative researchers typically rely on six methods in collecting data. Interviews, direct observation, documentation, archival records, physical artifacts and participant observation are the six most essential methods in collecting data.

In this study, I rely on direct observation, documentations and archival records as data collection techniques. Concerning the empirical evidence, it was collected from international wind research centers reports, academic articles and journals and official websites of wind turbine manufacturers. In addition, reliability and validity are used to measure the research progress and success after answering the research questions. Using reliability in this research helps the researcher to minimize the error and deliver high quality and authentic data to reach detailed answers for the research questions.

5. THE FACTS OF WIND POWER MAIN MARKETS IN THE MIDDLE EAST AND NORTH AFRICA

In this chapter, there will be an analytical study about the empirical data of wind power main markets. Iran, Egypt, and Morocco are the only countries in the Middle East and North Africa with large-scale wind power installations. The empirical data analysis of these main markets will lead to identify the status of wind power productivity and development issues in the Middle East and North Africa and its futuristic developments scope. The analysis process will investigate deeply in the wind resources, the policy environment of renewable energy, existing wind farms, markets developments, wind power industry, and the futuristic plans.

Concerning the report of annual market updated 2011 by GWEC, the total installed wind power capacity in the Middle East and North Africa was 1103 MW by the end of 2011. Egypt came in the first spot with 550 MW as total installed capacity while Morocco came in the second position with 291 MW. Iran came in the third position with 93MW as total installed capacity by the end of the year. The following table illustrates the total installed capacity by the end of 2011 in the Africa and Middle East region.

Country	End 2010	New 2011	Total End 2011
Egypt	550	-	550
Morocco	286	5	291
Iran	90	3	93
Cape Verde	2	23	24
Other*	137	-	137
Total	**1,065**	**31**	**1,093**

Table 10. The total installed capacity by the end of 2011 in the Africa and Middle East region (GWEC)

Other * (South Africa, Israel, Nigeria, Jordan, Kenya, Libya and Tunisia)

5.1. Wind power in Iran

Despite the international sanction, Iran is the only country in the Middle East with any large-scale wind power installations. Currently, the country has two wind farms and other two wind sites with small installed capacities. According to the latest studies, Iran has a potential for wind power development of around 15 GW due to its geographical location. By the end of 2011, the country total installed capacity reached 93 MW (Pullen et al. 2010).

5.1.1. Highlights on Iran background

In the past Iran was called “Persia” until 1935 when the country became to be known as the Islamic republic of Iran in 1979. The country is the 18^{th}- largest in the world in the terms of area (1,648,195 km2 – and 2400 km coastline) its estimated population in July 2012 is 78.868 million. Iran is located in the Asia and bordered on the north by Azerbaijan, the Caspian Sea, Armenia and Turkmenistan. It borders the Gulf of Oman and the Persian Gulf from the southern side while Tehran is the capital and the largest city in the terms of area and population (Central Intelligence Agency 2010).

Iran is one of the five founding members of OPEC organization, and is one of the four world’s top holders of natural gas and proven oil reserves. In 2010, Iran came third as the third-largest exporter of crude oil globally after Saudi Arabia and Russia. Moreover, the country has the world’s second largest natural gas reserves, but the sector is still under development and used mostly to meet the domestic demand. Natural gas is accounted 54 % of the country total domestic energy consumption while most of the energy remained consumption is attributable to oil and marginal contributions from hydropower and coal. In the summer of 2010, the international sanctions that enacted against Iran have slowed the development process across the energy sector, especially affected on upstream investments in oil and gas projects.

Regarding the country analysis briefs report by the Energy Information Administration (EIA), Iran generated 201.6 billion Kilowatt-hours (BKWH) of electricity and consumed around 161.5 BKWH by the end of 2009. This electrical power was generated from a network capacity of 53GW, which is clearly strained during the times of peak demand. According to the statistics, 97% of total electricity supply was generated by conventional thermal electric power while the 3% remaining was from hydroelectric and wind power sources. Iran's electricity infrastructure status is largely in a state of dilapidation and rolling blackouts especially during summer time while some of the power plants are running as low as 10% of their nameplate capacities. Due to the increasing demand on electrical power, Iran has focused on meeting the highest demand by expanding gas-fired combined-cycle and hydroelectric power capacity. Meanwhile, the Iranian government put plans for expanding its wind power capacity by reaching 400 MW in the coming years.

When it comes to electricity trade, Iran is considered a net exporter of electric power. Currently, Iran exports electricity to the neighboring countries including Armenia, Afghanistan, Turkey, Pakistan and Iraq. According to November 2011 agreement between Iran and Armenia, the two countries will increase the volume of electricity that they deliver to each other on a seasonal basis. Total volume of electrical power swapped between the two countries will rise from 350MW to reach 1200MW in May 2012. The following figure illustrates the amount of electricity generation and consumption in Iran (BKWH) between 1990 and 2008 (U.S. Energy Information Administration 2012).

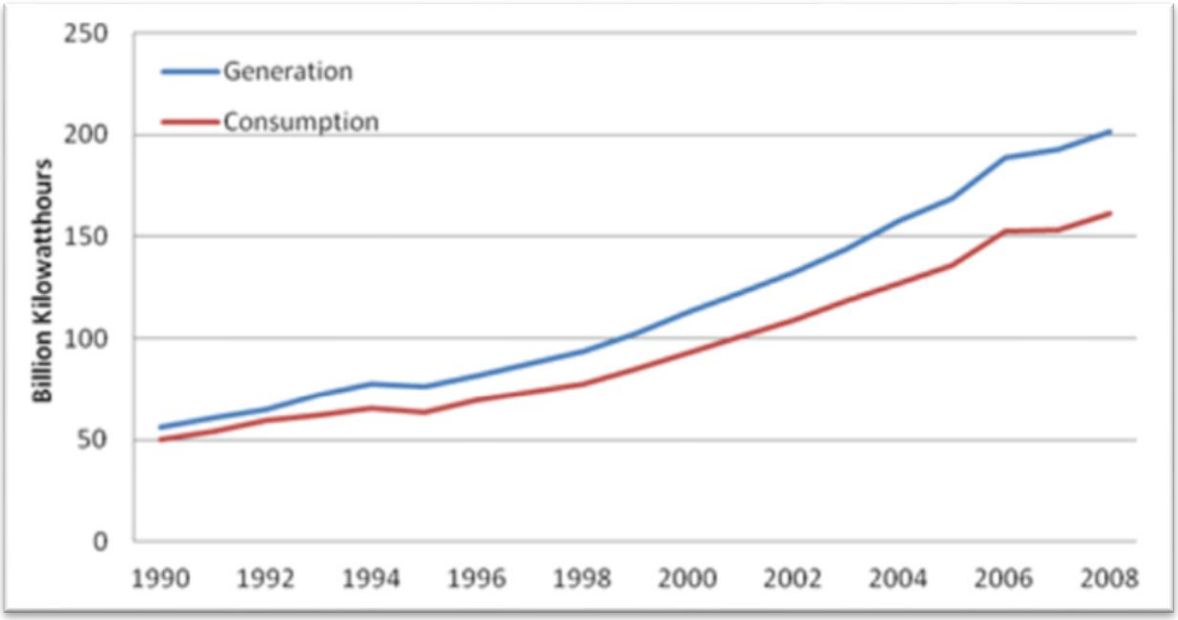

Figure 14. Iranian electricity generation and consumption 1990-2008 (U.S Energy Information Administration)

5.1.2. Highlights on Iran wind potential and wind Atlas

According to the Iranian Renewable Energy Organization (SUNA), Iran has the best wind resources in the Middle East region due to its geographical location. SUNA preliminary studies have estimated wind energy potential of at least 6.500 MW and it can reach 15 GW.

Iran’s best wind resources are located in the mountainous part of the country, along the Alborz and Zagros mountain chain. In the past 10 years, the Iranian ministry of energy had serious programs for the evaluation of the wind energy potential in the country based on economic perspectives. At the first stage, there was an evaluation process, performed on a wide range in the country regions. The second stage was to prepare a wind atlas for the country after identifying the exact locations with the best wind resources. The preparation process for wind atlas began with installing 53 wind synoptic stations all over the wind potential locations in Iran. These stations recorded wind data every 10 minutes. In addition, the effects of turbulences and thunderstorms on wind streams were taken into consideration in the results. One of the best wind potential locations in Iran is Sefid Rood Valley. This location has an excellent wind stream due to its high speed and durability. The Manjil wind site is located at the southeastern part of the Sefid Rood Valley and it area is around 2 x 106 m2. To evaluate the wind potential in Manjil wind site, 10 synoptic stations were installed and the data collected in 10, 20 and 40 meters high for wind speed and 20 meters for wind direction each 10 minutes. Finally, data were analyzed be the statistical methods using Smada, Excel and Spss software's. The following table illustrates the wind speed variations at 10, 20 and 40 meters heights for 6 stations at Manjil site.

Station	**Ali Abad**	**Babaeian**	**Jarandagh**			**Esfestan**			**Jirandeh**			**Mirkhovand**		
Height (m)	10	10	10	20	40	10	20	40	10	20	40	10	20	40
Average wind Speed (m/s)	9.2	4.9	4	7	7.5	4	5.1	4.8	5.5	6.2	6.4	4.2	4.6	5.5

Table 11. The average annual wind speed measurements at 6 stations of Manjil area (SUNA)

The following figure illustrates Iran wind Atlas at the height of 50 meters (Ameri, Ghadiri & Hosseini 2005).

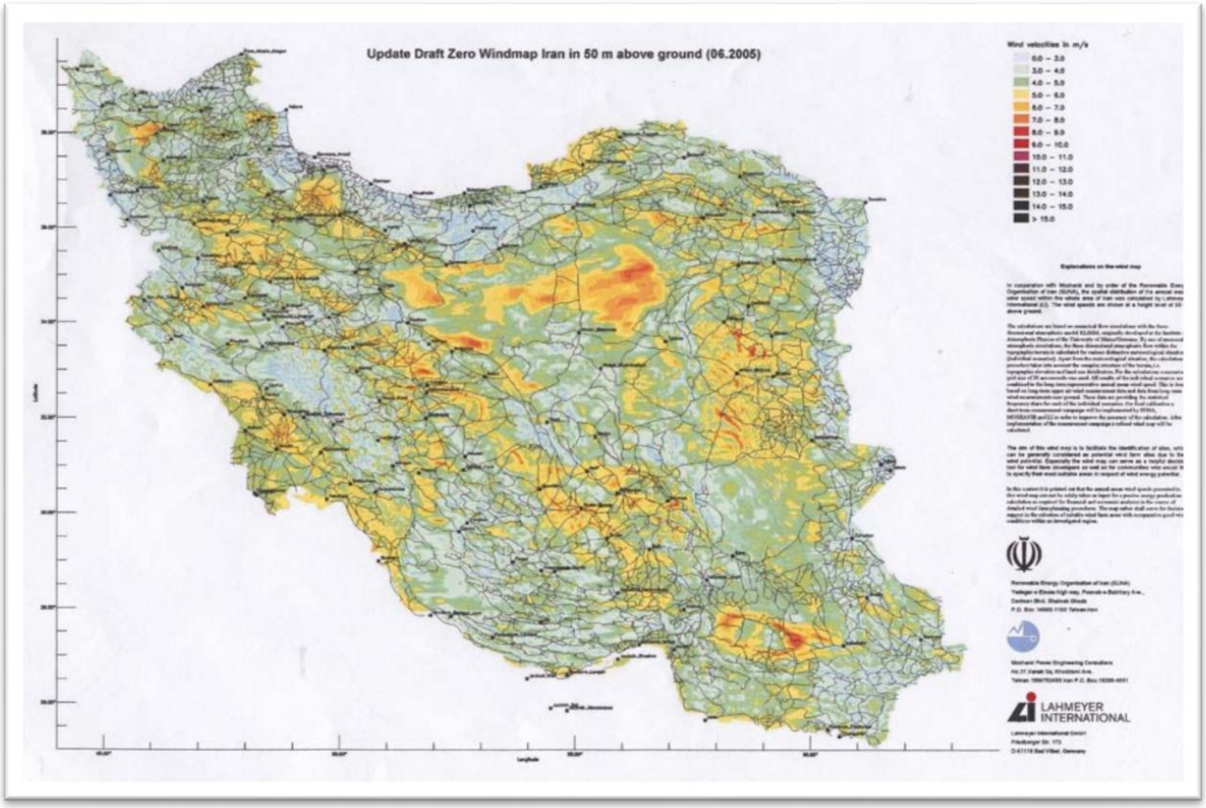

Figure 15. Iran wind Atlas at the height of 50 meters (SUNA)

5.1.3. Highlights on the policy environment for renewable energy in Iran

Iran is rich in oil and natural gas reserves and the income from fossil fuels dominates the economy and affects the country energy policy. In 2010, Iran adopted a new strategy by shifting towards diversifying its energy mix with eliminating its energy subsidies strategy. The new strategy helps to free up over 6o billion USD of the public fund, which is the majority of these funds, invested in renewable sector. In addition, the Iranian government has a clear vision of developing the country's industry to become wind energy hub for the Middle East region.

So far, there is no clear policy for wind energy in Iran but the Iranian ministry of energy has paid considerable efforts for developing a legal and financial framework to support wind power growth in the country. Also, the Iranian government launched a law for privatizing the power sector in the country. This new law adopted on 20GW of thermal power capacity while it floated the two major wind farms in the country (Manjil and Binalood) on the stock market.

In 2009, the tariff of electricity, generated from renewable energy sources raised from 900 rial (EUR 6 cents) to 1.300 rial (EUR 9 cents) per KWH on peak and off-peak hours by adopting the Renewable Energy Power Purchase Act. In addition, any private firm wants to purchase electrical power generated from renewable energy sources in Iran has to sign a Power Purchase Agreement (PPA) for 20 year with SUNA while this agreement is backed by a letter of credit. The Foreign Investment Promotion and Protection Act protecting investors against political risks, covers all foreign investments in Iran. However, the international sanctions against Iran have put huge negative impacts on the development of renewable energy sector due to prohibiting any technical or financial foreign investments into the country (Pullen et al. 2011).

5.1.4 Existing wind farms and market developments

In the end of 2011, Iran total wind installed capacity was 93KW. In the last two years, Iran installed only 3MW as new installed capacity, which is a long way behind the government target of 500 MW by 2009. According to the Iranian ministry of energy, wind power generated around 220 GWH of electricity over the year in 2010. In addition, the Iranian government set a new target of 1.5GW by the send of 2013, which seems to be a long way behind it as well. The following table illustrates the total installed capacity in Iran between 2002 and the end of 2011 (Pullen et al. 2011).

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
MW	12	12	15	20.5	48	74	84	90	90	93

Table 12. Iran total installed capacity between the end of 2002 and 2011(GWEC)

Iran has two large wind farms and two-wind sites with small installed capacities. The wind farms are the Manjil wind farm with 62.08 MW as total installed capacity and Binalood wind farm with 28.4 MW as total installed capacity. Moreover, the wind sites are Loutek wind site with 0.66 MW and Eouibnali wind site with 0.66 MW as total installed capacity while these sites are used as research projects.

According to SUNA, the implementation of Manjil wind farm project took seven years (2002 to 2009) to be ready. The wind farm includes two 550 KW Nortank wind turbines while the rest are 600 KW wind turbines (SSN47-660), manufactured by domestic company under the license of Vestas the Danish manufacturer. The next large wind farm was commissioned in the Dyzbad at the Binalood mountain, which is located in the northeastern part of the country. The implementation of this project took around one year (2006 to 2007) while the wind farm includes forty-three 660KW wind turbines with total capacity of 28.4 MW (Ameri et al. 2005)

5.1.5. Highlights on the wind industry in Iran

Due to the international sanctions, it has become impossible to import some of the critical components for the 660 KW turbines, manufactured by the Iranian wind turbine manufacturer SabaNiroo. The company began to manufacture these components in house while the production line started to meet the demand again by the end of 2010.

SabaNiroo is considered as the first and only wind turbine manufacturer in the Middle East region. The company was founded in April 2001 while the official establishment was in November 2003 by the ministries of energy and industry in Iran. SabaNiroo main objective is to become the wind industry hub in the Middle East region by designing and manufacturing large wind turbine capacities as well as supplying other composite parts, material testing and providing solutions. The company core competencies preform consultative and executive services in manufacturing of large wind turbine as well as giving the needed technical and after sales services. SabaNiroo is capable to produce composite blades of wind turbines with production capacity of three blades a week. The company has

3000 m² used for the nacelle assembly process. The company also has the ability to manufacture a 660 KW wind turbine under the license of Vestas the Danish manufacturer.

SabaNiroo main clients are SUNA and Iran Power & Water Equipment and Services Export Company (SUNIR). The company had contract with SUNA for manufacturing, installing and commissioning 143 units of 300,550 and 660 KW wind turbines for Manjil wind farm. In 2006, the company manufactured, installed and commissioned 43 units of 660KW wind turbines for Binalood wind farm in Khorasan province. Meanwhile, SabaNiroo has started exporting its technology into neighboring countries such as Armenia and Pakistan. The company signed a contract with SUNIR for a 40% investment in the 50 MW Jhimpir wind farm in Pakistan as well as manufacturing, installing and commissioning 2.46MW including 660 KW wind turbines in Armenia first wind farm. Another potential market for SabaNiroo is Georgia, where prospective projects are currently examined (Pullen et al. 2011).

5.1.6. Highlight on the future of wind power in Iran

The future of wind power in Iran is so promising due to its excellent wind resources and the considerable efforts paid by the Iranian government to develop this sector. Meanwhile, there are many challenges affecting the growth of wind energy sector such as the international sanctions, lack of strategic planning for renewable energy program and lack of clear policy for wind energy in the country.

In 2010, The Iranian government sat a new target of 1.5GW by the end of 2013, which seems to be a long way. Up to now, a wind atlas is available for three different altitudes (40m, 60m and 80m) and 42 sites were identified appropriate for wind power development. According to SUNA, the first private wind farm in the country with a capacity of 300MW started in 2011 and there is an ongoing project at Manjil site with 100 MW as new-installed capacity (Pullen et al. 2011).

5.2. Wind Power in Egypt

The renewable energy sector has grown rapidly over the last two decades in Egypt, thanks to the considerable commitment and the successful international cooperation paid by the Egyptian government to develop this sector. In 1986, the New and Renewable Energy Authority (NREA) was founded. NERA objectives are assessing the country's renewable energy resource, investigate technology options through research studies, and demonstration projects as well as introduce advanced technologies into the Egyptian market with supporting the domestic wind industry.

In the 1980, the first large-scale grid connected wind energy project was installed In Egypt. By the end of 2010, the total installed capacity reached 55O MW by adding 120 MW as new installed capacity while in the last year Arab spring movements severely influenced the process of renewable energy development in Egypt (Pullen et al. 2011).

5.2.1. Highlights on Egypt background

Egypt is located in the Northern side of Africa and bordered on the north by the Mediterranean Sea. The country borders Sudan from south and the Red Sea from east while it includes the Asian Sinai Peninsula. Libya is bordering Egypt from west while Cairo is the capital and the largest city in the terms of area and population. The country is the 30th largest in the world in the terms of area (1,001,450 km2 – and 2,450 km coastline) its estimated population in July 2012 is 83,688 million (Central Intelligence Agency 2010).

In general, Oil and natural gas production plays a sizable role in Egypt's economy as well as the revenues from the Suez Canal, which is an important transit point for oil shipments out of the Persian Gulf. In fact, the total oil production has declined from 935,000 barrels per day in 1996 to reach 660,000 barrels per day in the current time. The oil consumption in the country is slightly higher than production, which leads to rely on small volume of oil imports to meet the domestic demand. However, decreases in oil production have been compensated by the rapid development of the natural gas sector for both domestic consumption and export. The natural gas sector has played a significant economic role for Egypt over the past decade. Nowadays, Egypt considered as main gas producer and strategic source for the European natural gas imports. In addition, Egypt has a pipeline network for exporting natural gas to the Eastern Mediterranean countries as well as a liquefied natural gas (LNG) exports to Asia, America and Europe. The following figure illustrates the total consumption share of different energy types in Egypt by the end of 2008 (U.S. Energy Information Administration 2012).

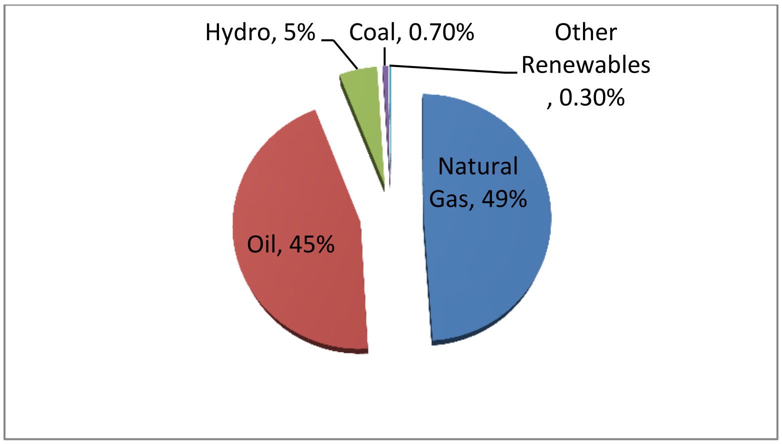

Figure 16. Total energy consumption in Egypt, by type in 2008 (EIA)

According to EIA, Egypt total installed capacity for electricity generation was 24.7 GW in the end of 2010. This total installed capacity was divided into 21.4 GW as thermal capacity, 2.8 GW as hydro capacity and 0.522 GW as wind power capacity. Meanwhile, the electrical consumption in Egypt is increasing much faster than the capacity expansions and the government is planning to invest over 100 billion USD in the power sector for the coming 10 years. This increasing demand forces the government to ask for financing from external sources. The private sector, international organization and renewable energy funds have all provided new investments in the power sector. Moreover, the Egyptian government aims to produce 20% of its electricity from renewable energy by 2020. The following table shows the latest statistical overview on the Egyptian energy sector.

Proven Oil Reserves (January 1, 2011)	4.4 billion barrels
Oil Production (2010)	660 thousand barrels per day
Oil Consumption (2010)	710 thousand barrels per day
Refining Capacity (2009)	975,000 barrels per day
Proven Natural Gas Reserves (Jan, 2011)	77.2 trillion cubic feet
Natural Gas Production (2009)	2.21 trillion cubic feet
Natural Gas Consumption (2009)	1.57 trillion cubic feet
Recoverable Coal Reserves (2009)	23.1 million short tons
Coal Production (2009)	0.03 million short tons
Coal Consumption (2009)	1.39 million short tons
Electricity Installed Capacity	24.7 Giga watts
Electricity Generation (2008)	124 billion kilowatt hours
Electricity Consumption (2008)	109 billion kilowatt hours
Total Energy Consumption (2008)	3.2 quadrillion Btus
Energy Intensity (2008)	7,681 Btu per $2005-PPP**

* The total energy consumption statistic includes petroleum, dry natural gas, coal, net hydro, nuclear, geothermal, solar, wind, wood and waste electric power.

**GDP figures from Global Insight estimates based on purchasing power parity (PPP) exchange rates.

5.2.2. Highlights on Egypt wind potential and wind Atlas

Egypt had to provide the necessary reliable information about its wind resource as well as develop and refine its legal and regulatory framework for wind power in order to meet its plans by relying more on wind power to generate electricity.

In 2003, the first wind atlas was published for the Gulf of Suez coasts. The detailed wind atlas illustrates that Gulf of Suez coasts has an excellent wind regime with wind speed of 10 m/s as well as it has the advantage of being the closest to where electricity is more demanded. According to the primary studies, the Red Sea region can host around 20GW of wind power. At the same time, a new version of wind atlas was published in the end of

2006. This new wind atlas expanded to cover the entire country, indicating that large desert regions of both the east and the west of the Nile River as well as parts of Sinai have average annual wind speeds of 7-8 m/s. However, the Northwestern part of the Mediterranean coast, from Sallum to Alexandria, seems to be a region of somewhat lower wind resource than it was assumed.

According to NERA, the regional wind climates of Egypt have been determined by using two independent methods. The first method is a traditional one, based on observing wind data from 30 stations located in the wind potential areas all over the country then analyzing these data. Twenty- two stations were installed specifically for the wind atlas investigation with masts between 25 and 47 meter while the other eight are standard stations with a10-meter mast. The Northwest Coast, the Northeast Coast, the Gulf of Aqaba, the Gulf of Suez, the Red Sea and the Western Desert are the six regions, which are presenting the most promising regions for wind energy exploitation. Meanwhile, logistic aspects have limited the site section somewhat as large parts of the mountainous and Western Desert is inaccessible. The wind measurements have been analyzed according to the wind atlas methodology in order to prepare them for wind resource assessment and siting. The Egyptian observational wind atlas was based on more than 150 'measurements years' measured at 30 stations; corresponding to more than 5 million wind observations. The second method was the numerical method, which uses the so-called KAMM/WAsP model. The Karlsruhe Atmospheric Mesoscale Model (KAMM) is a mesoscale model that models the wind flow on a much larger scale than the wind atlas model WAsP; typical domain sizes are between 100,000 and 1,000,000 square kilometers. The following figure shows the wind resource map of Egypt at 50 meter height, which has been determined by mesoscale modeling.

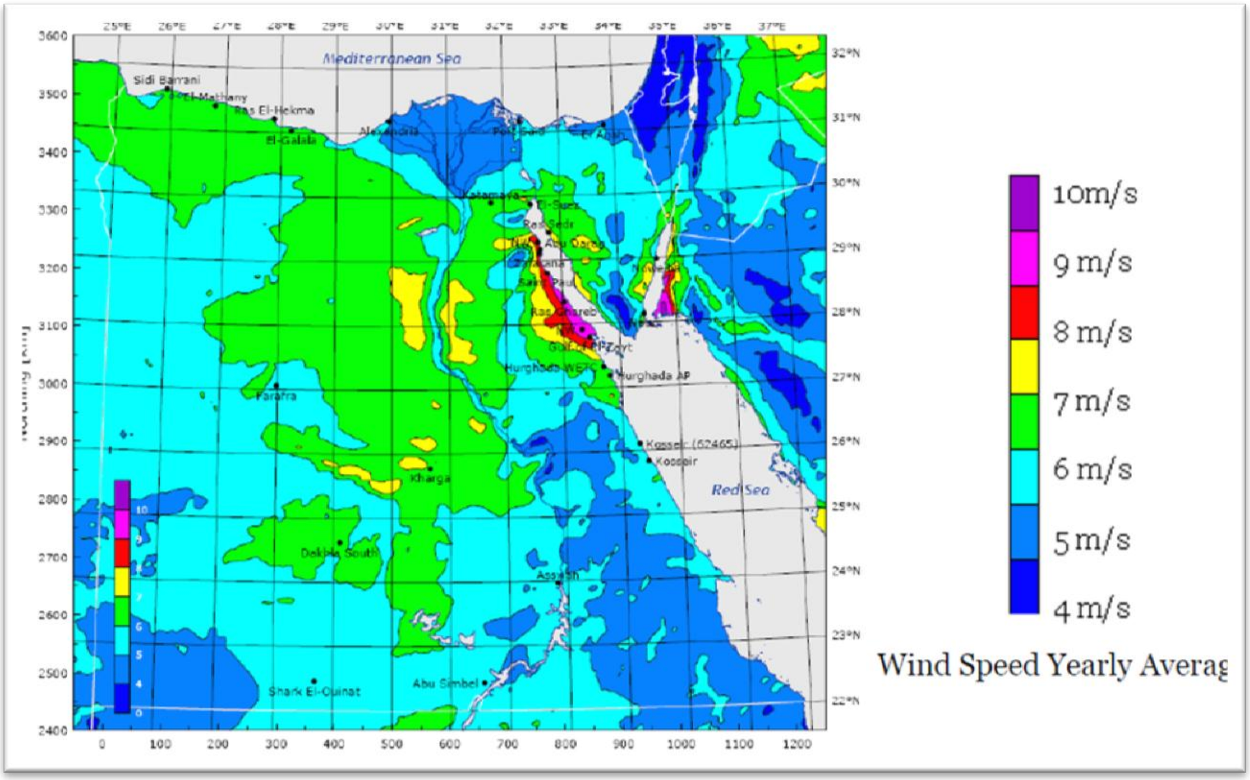

Figure 17. Wind resource map of Egypt at 50, determined by mesoscale modeling (WindAtlas for Egypt, 2006).

According to NERA, the purple, pink and red areas on the wind atlas map are classified as the most sustainable areas for hosting wind farms with fast wind speeds. The following figure shows the offshore wind resource map of Egypt at 50 meter height, which has been determined by mesoscale modeling (Mortensen, Said & Badger 2005).

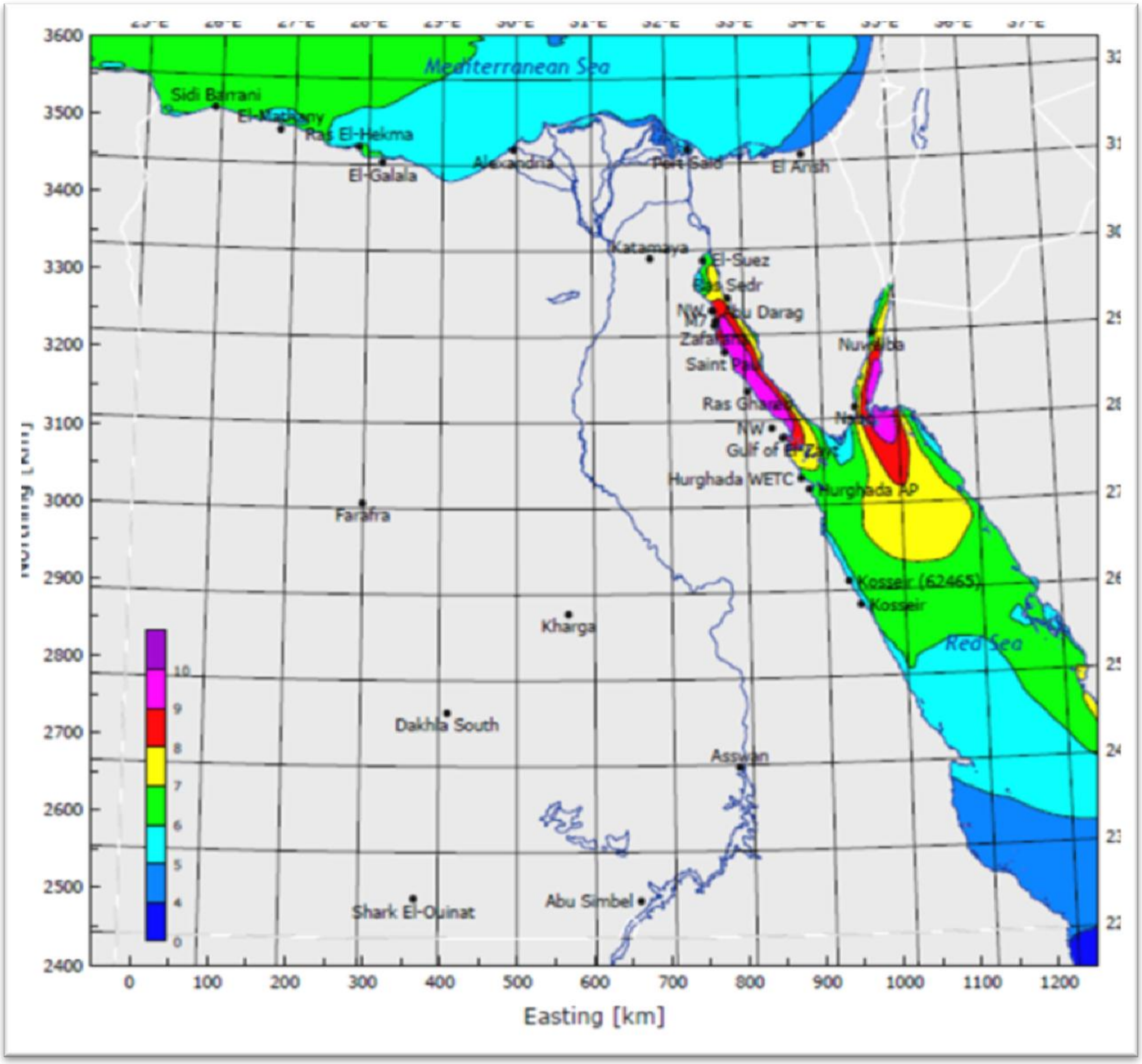

Figure18. Offshore wind resource map of Egypt: at 50 m, determined by mesoscale modeling (Wind Atlas for Egypt, 2006).

5.2.3. Highlights on the policy environment for renewable energy in Egypt

In February 2008, the Egyptian Supreme Council of Energy approved the new strategy for the electric power, which is based on diversifying sources of production, rationalizing the use of energy and expanding use of renewable energy sources. The new strategy aims at increasing the contribution of renewable energies by producing 20% of the total electricity generation by the end of 2020. Moreover, the share of electricity generation from wind power is estimated around 12% of the total electricity generation, which presents around 7.2 GW of the total capacities. The other 8% will be produced from other renewable energy applications such as solar energy and hydropower.

In 2010, the Egyptian cabinet approved a new electricity act, which aims to encourage the private sector, strengthen the regulatory agency and support the ongoing market reforms. This new act includes policy to support wind energy by allowing private developers to implement wind energy projects including the following measures:

- For future wind projects, Egyptian government earmarked 7600 square kilometers of desert while all the permits for land allocation have been obtained by NERA.
- NERE will prepare and provide all the environmental impact assessments, including the studies of bird migration.
- The Egyptian government will guarantee all the 20-25 years Power Purchase Agreements (PPA).
- All renewable energy equipment's are exempted from customs duties and all the projects will benefit from carbon credits under the Clean Development Mechanisms (CDM).

The Egyptian government has outlined two phases for producing the 12% (7.2 GW) target by the end of 2020:

i. Phase 1: The Egyptian government has adopted a competitive bids approach for the private companies. These tenders will be based on request to supply electricity by building, owning, operating (BOO) wind farms and selling electricity.

ii. Phase 2: A feed-in tariff system will be applied in 2012. This system will take into consideration the prices achieved in tendering process (New & Renewable Energy Authority 2005).

5.2.4. Existing wind farms and market developments

By the end of 2011, Egypt total wind installed capacity was 550 MW. According to the NERA forecast, the country needs to install 1 GW (around 660 turbine units) of newly installed capacity per year by 2021 to reach the government target.

In 2010, Egypt was able to install 120 MW as new installed capacity while the country could not add any new wind capacity in the last year due to the Arab spring movements. The following table illustrates the total installed capacity in Egypt between 2000 and the end of 2011.

year	2000	2002	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
MW	5	5	68	98	145	145	230	310	365	430	550	550

Table 13. Egypt total installed capacity between the end of 2000 and 2011(GWEC)

Egypt has two large wind farms. Zafarana wind farm, which is located by the Red Sea coast and has been constructed in eight phases since 2001, in cooperation with Denmark, Spain and Germany. In 2010, a new 120 MW of wind capacity was added to Zafarana in cooperation with the Danish International Development Agency (DANIDA), taking the total installed capacity to 545 MW. The farm includes 698 turbines with different technologies such as 0.6MW Nordex, 0.66MW Vestas and 0.85MW Gamesa. Finally, Zafarana wind farm generated 1.147 GWh of wind electricity by the end of 2010.

Hurgahda wind farm is the second farm in Egypt with five MW as total capacity. The farm is located in the north of Hurgahda city in the Gulf of El Zayt (Pullen et al. 2011).

5.2.5. Highlights on the wind industry in Egypt

NERA encourages the localization of wind industry in Egypt based on join venture, technology transfer and under license or any other forms, whatever is the most appropriate. The first experience of using local turbine components was in Hurghada wind farm project while around 40% of the components were manufactured locally such as blades, towers, mechanical and electrical joints. In general, the donor-funded projects are the increasing demand backbone for local components in Egypt. In addition, several large local enterprises manufactured and supplied turbine components especially wind towers and electrical auxiliaries. Ferrometalco and NSF are the two local manufacturers that have been awarded most of the contracts in terms of wind towers for donor-funded projects in the country.

According to the Egyptian-German Private Sector Development Program, Egypt has the essential capabilities to become one of the component suppliers' hubs for wind industry at MENA region due to its infrastructure, existing facilities, level of technological maturity and the increasing support towards the wind industry. As clear example of Egypt capabilities is the Sewedy Wind Energy Group (SWEG), which is a newly born company. Currently, SWEG is able to manufacture and supply wind turbines and their components like wind towers and wind blades. The company has established a joint venture tower production facility with the German manufacturer SIAG in Sukhna while the production capacity is around 400 towers per year. In addition, the company had set up an assembling facility for 1.65 MW wind turbines according to the standards and quality levels of the M-torres facility in Spain.

Finally, the Arab Organization for Industrialization (AOI) has been involved in wind energy generation in Egypt since its beginnings in Hurghada project. The company is in the negotiating process for setting up a wind turbine and blade manufacturing facilities with international suppliers (Environics 2010).

5.2.6. Highlights on the structure of wind industry and its reflections on local developments

The turbine is the technological core of the wind industry and its most expensive component, which presents around 40% of the total investment costs. Meanwhile, tower is the most accessible technological component and it represents around 15 % of the total investment cost. The main challenge in local tower manufacturing is that tower designs have to be provided by the turbine manufacturer while the deepening on local manufacturing is needed to reduce the investment costs. In addition, supporting the local tower manufacturing will allow for the localization of operation and maintenance (O&M), which will increase the capacity building for growing markets such as the Egyptian market and will lead to reduce the running costs.

In wind turbine, gearbox is the most technically demanding part to manufacture locally and it is the most expensive component as well. This gearbox has a specific characteristic other than the normal requirements for gears, which it transfers variable mechanical rotary speed to stable speed that feeds into the generator. In addition, gearbox is the most problematic component in terms of O&M. Meanwhile, new technology had appeared at the global level to address this critical spot in the system through gearless turbines that shift variable speeds directly to the generator, but it requires larger size of generators. In Egypt, SWEG group is considering the gearless turbines of M. Torres to reduce the O&M problems that effect existing wind farms.

The rotor is the final main component of the wind turbine, which includes the blades, hub and shaft. This component represents around 20 % of the total investment cost while blades are aconsidered as the main part of the rotor. In general, blades are manufactured from glass-reinforced plastics (GRP), which are already used in Egypt for products such as water pipes and bathtubs. The main problem is facing the development process of local blade manufacturing in Egypt is the industrial design and quality control while the size issue has been addressed.

Finally, other electrical systems such as cables, transformers and electrical control systems represent the remaining 25 % of the total investment cost. However, Egypt has the capabilities to deliver these electrical systems due to the existence of qualified suppliers while the country has strongly developed the local cables and transformers industry to become an export items (Environics 2010).

5.2.7. Highlights on the supplier network in Egypt

In general, it is rarely to have cooperative relationships among companies in the same domain especially in the Egyptian market due to the lack of transparency in its local environment, which is normal at a stage when market positioning is still taking place.

However, in wind power case there are intentions for changing this behavior among companies to reach this cooperative relationship in the future epically with the rapid market growth. For Instance, SWEG is the first company in Egypt had declared its plans publicly while other tower manufacturers are involved only on a project basis and they may benefit from growth in the wind power market. Meanwhile, small turbine manufacturers do not have a serious presence on the market. Other major player, AOI, tried to encourage greater market coordination and sharing information through meeting with all interested investors and NREA but these efforts were unsuccessful in the end.

Finally, based on information on its website, The Egyptian Wind Energy Association (EGWEA) does not have any intentions to enter the manufacturing domain (Environics 2010).

5.2.8. Highlight on the future of wind power in Egypt

Concerning the Egyptian Supreme Council wind strategy and NERA official forecast, the future of wind power in Egypt is so promising. The country needs to install each year a 1 GW of newly installed capacity until 2021 to be able to reach the 12% of the total electricity generation through wind power.

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
New Capacity (MW)		320	340	500	500	750	900	900	1000	1000	1000	1000
Total (MW)	550	870	1210	1710	1710	2960	3860	4760	5760	6760	7760	8760

Table 14. Tentative schedule for installed wind farm capacity, 2011–22 (Source: Elsobki et al)

According to NERA, 1120 MW of new installed capacity will be installed in Hurgahda wind farm. This new capacity will be in cooperation with the European Investment Bank (EIB), Japan, Germany and Spain, which will include the following phases:

- Phase 1 includes a 200 MW in cooperation with EU, KFW bank and the EIB. The contractor was selected at the beginning of last year. It is planned to start operation by the mid of 2013.
- Phase 2 includes 120 Mw in cooperation with Spain and 220 MW in cooperation with Japan.
- Phase 3 includes a 220 MW future project in cooperation with Abu Dhabi's MASDAR program, 180 MW in cooperation with Spain and 200 MW in cooperation with Germany, the EID and the EU. These projects are still under preparation.

In May 2009, the Egyptian government published an international tender for inviting local developers and private international companies to submit their prequalification documents for the first competitive bid to plan build and operate a 250 MW wind farm. This tender was at the Gulf of El Zayt in cooperation with the World Bank, but the Egyptian government was aiming at installing a 2 GW of wind power in the Gulf of Suez region. This project should be developed on four stages while the first tender was published in January 2010 for two projects of 250 MW each. These two projects are based on a build-own-operate contract for 20 years while other tenders are expected to be published in the coming years (Pullen et al. 2011).

5.3. Wind power in Morocco

Morocco is one of the poorest countries in MENA region in terms of oil and natural gas reserves. The country is importing 95% of its oil and coal needs, which are used in the energy sector while there is 8% of annual increasing demand on the electricity sector. All the pervious challenges had put an extra pressure on the government to adopt a fast strategy by relying more on renewable energy resources. In the end of 2011, Morocco has 291 MW as total installed capacity of wind power while just 5 MW was added last year as new install capacity (Pullen et al. 2011).

5.3.1. Highlights on Morocco background

Morocco is located in the Northern side of Africa and bordered on the north by the Mediterranean Sea and the North Atlantic Ocean. The country is surrounded by Algeria and Western Sahara while Rabat is the capital. The country is the 58th largest in the world in the terms of area (446.550 km2 – and 3500 km coastline) its estimated population in July 2012 is 32.309 million (Central Intelligence Agency 2010).

Morocco is importing 95% of its oil and coal needs, which are used in the energy sector while the government spends around 4.4 billion EUR from the budget just for importing oil annually. In the end of 2010, the electricity generation in Morocco was frequently generated by oil, which presents around 60% of the total electricity generation followed by 23% from coal while gas presented around 4% and renewable energy sources (wind and hydro) that contributed around 5% of the total electricity generation. Finally, the country imported around 8% of the total consumed electricity. Meanwhile, the increasing electricity demand is expected to double by 2020 and the government is starting to be under real pressure due to the imported oil bill. In 1980, the Moroccan government began promoting renewable energy while nowadays the country is considered as one of the leading wind power nations in the MENA region (Pullen et al. 2011).

5.3.2. Highlights on Morocco wind potential and wind Atlas

Wind power is one of the most promising renewable energy sectors in Morocco due to its excellent wind regime and its long coastline. According to the Moroccan Center for Renewable Energy Development (CDER) studies, the country's average wind speeds are between 6 and 11 m/s in several locations while the total potential for wind power was estimated around 2600 GW. The following table shows the study results of wind energy potential in Morocco by CDER and the German Office for Technical Cooperation (GTZ) in July 2007.

Total Potential	Technical Potential	Estimated Capacity in 2010	Estimated Capacity in 2012	Estimated Capacity in 2020
2.654.310 MW	1.632.030 MW	563 MW	1065 MW	3258 MW

Table 15. Wind energy potential of Morocco (Results of study CDER and GTZ- July 2007

Tangier, Tetouan and Essaouira are the regions with excellent potential for exploiting wind energy while the wind speeds are between 9.5 and 11 m/s at 40 meters height. Moreover, other areas such Tarfaya Laayoune, Dakhla, and Taza have annual average wind speed between 7.5 and 9.5 m/s at 40 meters height. In 1990, the wind energy evaluation program was launched by GTZ in collaboration with the Special Energy Program (SEP). The program was in two phases while the first phase has aimed at evaluating the country wind potential all along the coastline (3500 Km). Meanwhile, CDER has published a report about all the wind data collected in March 1995. The second phase of the program was based on evaluating the wind potential in the northeastern side of the country while it took around 5 years (1995-200). The following figure illustrates the wind resources map of Morocco (Enzili, Nayysa, Affani & Simonis 1998).

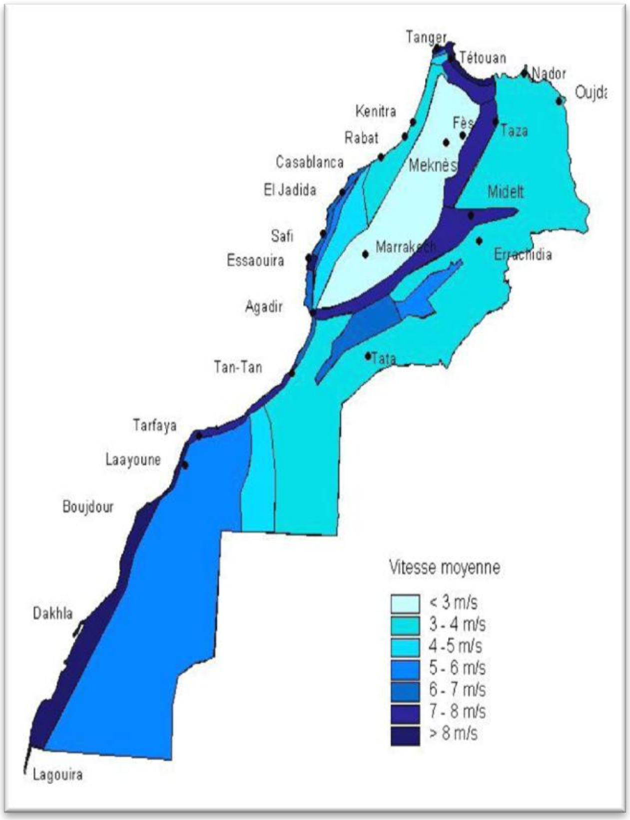

Figure19. Wind resources map of Morocco

5.3.3. Highlights on the policy environment for renewable energy in Morocco

According to the Moroccan government statistics, Morocco has a 6135 MW as total installed electrical capacity at the current time while it is planned to reach 14.580 MW by the end of 2020 to meet the increasing demand. Meanwhile, the renewable energy sources will participate in 42% of the new installed electrical capacity while Morocco has to install 2 GW each from wind power, hydro and solar energy to meet the 42% target. Finally, the electricity generation from renewable power sources will produce around 20% of the country's total electricity consumption by 2020.

Concerning the 2 GW of wind power, half of this new capacity will be implemented by the private investments through the "EnergiPro" initiative while the National Office of

Electricity (ONE) will plan the other half. Energipro initiative aims to encourage the industrial companies to implement their own energy projects that can reach the 50 MW while the production costs and tax rates will be reduced by the Moroccan government. Meanwhile, ONE will purchase any excess electricity produced by applying tariff system and it will guarantee an access to the national grid (Pullen et al. 2011). To support the framework for renewable energy sector in Morocco, the Parliament has adopted new legislation in January 2010 for the promotion of renewable energy development. This new law allows and authorizes for electricity generation from renewable energy sources by companions other than the ONE (law 13-09) while it includes also establishing a new agency for renewable energy efficiency (ADEREE) instead of the current Energy Development Centre CDER (law 16-09).

5.3.4. Existing wind farms and market developments

By the end of 2011, Morocco had had four large wind farms with 291 MW as total installed capacity. The country was not able to add more than 5 MW last year as new installed capacity while in 2010 Morocco added around 33 MW as new installed capacity. The following table illustrates the total installed capacity in Morocco between 2004 and the end of 2011.

Year	2004	2005	2006	2007	2008	2009	2010	2011
MW	54	64	64	124	134	253	286	291

Table 16. Morocco total installed capacity between the end of 2000 and 2011(GWEC)

The largest wind farm in Morocco is Tangier wind farm with 140 MW as total installed capacity, which generates around 526 GWh per year of electricity. The project was implemented in two phases between April 2009 and June 2010 while the project is located in Beni Mejmel, Allak and El Haoud areas near Tangier and Tetouan. The first phase consisted of 107 MW as total installed capacity while 33 MW were added to the second phase. Meanwhile, 165 units of Gamesa turbines (850 KW) were installed in the wind farm and the wind speed is estimated around 9 m/s at 40 meters height.

In April 2007, Amogdoul project was implemented by installing 60 MW of wind power as total capacity while the estimated production of electricity was around 210 GWh per year. This wind farm includes 71 units of Gamesa turbines (850 KW) and it has one of the best wind resources with 9.45 m/s as average annual wind speed at 40 meters height.

El Koudia Al Baida is the third largest wind farm in terms of capacity with 54 MW while the estimated production of electricity is around 200 GWh per year. This project was implemented in two phases between 2000 and 2001 by installing 84 units of Vestas turbines (600 KW) and average wind speed in this site is about 10 m/s at 42 meters height.

Lafarge project is the fourth wind farm in Morocco, which was implemented between 2005 and 2009. This project aims at produce electricity for the cement factory near Tetouan and its total installed capacity reaches 32 MW. Meanwhile, the project started operating with 12 units of Gamesa turbines (850 KW) while additional 10 MW were added to this project in December 2008, and other 12 MW in June 2009. This wind farm is generates electricity around 115 GWh per year and ONE purchases any unconsumed excess power (Pullen et al. 2011).

5.3.5. Highlight on the future of wind power in Morocco

Concerning the Moroccan government targets and plans for developing renewable energy sector, the future of wind power in Morocco is so promising. Meanwhile, the country has set its renewable energy targets by achieving 18% of electricity generation by the end of 2012, which seems to be a long way behind it.

Currently, ONE is under developing a framework for 1000 MW Integrated Wind farm Program that aims at producing electricity from wind energy, supporting the local wind industry and supporting the national research and development activities for wind power. In addition, ONE is the sole responsible for developing five wind farm projects with 850 MW as cumulative capacity. These projects will be implemented under a Build, Own, Operate and Transfer (BOOT) scheme. Meanwhile, there are undergoing projects for wind power pipeline that include a 300 MW wind farm to be installed near Tarfaya. Another example on the importance of wind power in North Africa regions is Sahara wind project. Benefiting from the exceptional North Atlantic Sahara Trade Wind resource blowing from Morocco through Mauritania, this project aims at producing and supplying over 5 GW of wind energy to the Euro-Mediterranean markets via a High voltage Direct Current transmission line (Pullen et al. 2011).

6. CONCLUSION

The aim of this study was identifying the status of wind power productivity and development issues in Middle East and North Africa regions and its futuristic developments scope by analyzing the markets with large-scale wind power installations. The analysis process was based on supply chain and marketing perspectives while the two major research questions were investigating the following:

- What is the current situation and scope of the wind power business in Middle and North Africa regions?
- What is the scope of futuristic development of the wind power business in the Middle East and North Africa Regions?

By the end of 2011, the total installed wind power capacity in Middle East and North Africa regions had been 1103 MW. Egypt came in the first spot with 550 MW as total installed capacity while Morocco came in the second position with 291 MW. Meanwhile, Iran came in the third position with 93MW as total installed capacity by the end of the year.

6.1. Middle East Region

The Middle East is rich in oil and natural gas, but the fact that the oil and natural gas reserves are unevenly distributed divides the countries region to major oil exporters and others are importers. On other hand, the increased prosperity in the major exporter's countries and the increasing population in the Middle East region put an extra demand on power sector, which has been growing rapidly. In meanwhile, the GCC countries are among the world's most carbon intense economies. All the previous challenges encouraged the majority of governments in the Middle East to think about alternative power resources and begin to develop national plans for renewable energy while, Iran is the only country in the region that has large-scale wind power installations. Moreover, there are increasing interests on wind power from the GCC countries but the current focuses are more on solar energy and nuclear power.

Up to now, Iran is on the right path to become a market hub for wind power in the region within ten years due to several factors. These factors can be summarized as the excellent wind resources that can be estimated around 15 GW as potential for wind power development, the availability of wind turbines local components and their manufacturing facilities and the involvement of private and international investments in the renewable energy sector. For the near future, the Iranian government is setting a new target by reaching 1.5 GW as total installed capacity by the end of 2013. This target seems to be long way due to the international sanctions, the high investment costs, lack of financial resources, lack of research and development (R&D), high cost of grid connection, lack of strategic planning for renewable energy program in the country and lack of clear law for renewable energy planning.

6.2. North Africa Region

The following seven countries: Egypt, Libya, Tunisia, Algeria, Kingdom of Morocco, Sudan and Western Sahara are known as the North Africans countries. This region is not rich in oil and natural gas as the Middle East regions except Libya and Algeria while other countries such as Egypt and Morocco, who are resources-scarce comparing to population. In general, North Africa region and the Middle East face the same challenges regarding the power demand and increasing population, but wind resources and average wind speeds are ranking amongst the highest globally. Meanwhile, wind resources and average wind speeds are the essential reasons illustrating why 95% of the African wind power capacities were installed in Egypt, Tunisia and Morocco. Furthermore, interesting prospects for wind power in this region is the geographical location that overlooks the Mediterranean Sea and the ability to connect Europe with North Africa by wind and solar power. All of the previous challenges and potentials encouraged a number of governments in this region to adopt ambitious renewable energy plans and targets for the near future. The Egyptian government is a clear example that sets a target to 20% as a share of its electrical demand operated by renewable energy until 2020. The wind power is expected to contribute 12% of the renewable energy and leave 8% operated by solar energy and hydropower. Morocco has set a target of 18% of its electrical demand operated by renewable energy until 2012.

Up to now, Egypt is considered as market hub for wind power in Africa and the country on the right path to become one of the component suppliers' hubs for wind industry at Middle East and North Africa due to its infrastructure, existing facilities, level of technological maturity and the increasing support from the government towards the wind industry. Egypt needs to install each year a 1 GW of newly installed capacity until 2021 to be able to reach the 12% of the total electricity generation through wind power while the country is under developing 1120 MW as new installed capacity for the next year in cooperation with the European Investment Bank (EIB), Japan, Germany and Spain. Meanwhile, the uncertainties associated with Arab Spring movements have affected the development process of renewable energy in Egypt while the political situation is playing a key role in the development of this sector. Morocco is importing 95% of its oil and coal needs, which are used in the energy sector while there is 8% of annual increasing demand on the electricity sector. All the pervious challenges had put an extra pressure on the government to adopt a fast strategy by relying more on renewable energy resources and wind power is one of the most promising renewable energy resources in the country due to its excellent wind regime and its long coastline. The country is aiming at increasing the renewable energy sources participation in the new installed electrical capacity by reaching 42% while Morocco has to install 2 GW each from wind power, hydro and solar energy to meet the 42% target. Meanwhile, the country is under developing a framework for 1000 MW Integrated Wind farm Program which aims at producing electricity from wind energy, support the local wind industry and support the national research and development activities for wind power.

To conclude, the wind power in the Middle East and North Africa is so promising for the next decades. The three main markets Egypt, Morocco and Iran will remain dominating for the next five years while there are increasing attention from other countries such as UAE and Oman.

7. REFERENCES

Alnasera, W.E & Alnaser, N.W (2011). *The status of renewable energy in the GCC countries* [online] 15, 3074- 3098. Journals of Renewable & Sustainable Energy Reviews. Available from Internet: <URL: http://www.sciencedirect.com.proxy.tritonia.fi/science/article/pii/S1364032111001249>

Ameri, Mohammad, Ghadiri, Mehdi & Hosseini, Mehdi (2005). *Recent Advances in the Implementation of Wind Energy in Iran* [online]. Bangkok, Thailand: The 2nd Joint International Conference on “Sustainable Energy and Environment (SEE 2006) 21-23, November 2006. Available from Internet: <URL: http://www.jgsee.kmutt.ac.th/see1/cd/file/B-002.pdf>

Azau, Sarah (2010). *Annual Report 2009* [online]. Brussels, Belgium: The European Wind Energy Association (EWEA). Available from Internet: <URL: http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/Ewea_Annual_Report_2009.pdf>. ISSN: 2032-9024.

Backwell, Ben (2012). *Gamesa back in wind top-five as GE drops out – analysts* [online]. Newspaper of Recharge. Available from Internet: <URL http://www.rechargenews.com/energy/wind/article306897.ece?cmpid=rss>

Baxter, Pammela & Susan, Jack (2008). *Qualitative Case Study Methodology : study Design and Implementation Novice Researchers.* The Qualitative Report 13:4, 544-559.

Blanco, Maria Isabel (2009). *The economics of wind energy* [online] 13. Journal of Business Renewable and Sustainable Energy. Available from Internet: <URL: http://www. http://www.sciencedirect.com/science/article/pii/S1364032108001299>

British Petroleum (2011). *BP Statistical Review of World Energy June 2011* [online]. London, United Kingdom: British Petroleum (BP). Available from Internet: < URL: http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2011.pdf>

Central Intelligence Agency (CIA)-The World Factbook (2010). Middle East: Egypt [online]. Available from Internet: < URL: https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html>

Central Intelligence Agency (CIA)-The World Factbook (2010). Middle East: Iran [online]. Available from Internet: < URL: https://www.cia.gov/library/publications/the-world-factbook/geos/ir.html>

Central Intelligence Agency (CIA)-The World Factbook (2010). Middle East: Morocco [online]. Available from Internet: < URL: https://www.cia.gov/library/publications/the-world-factbook/geos/mo.html>

CN North America's Railroad (2009). *The Logistics of Transporting Wind Turbines - Reducing Inefficiencies, Costs and Community Impact by Streamlining the Supply Chain* [online]. Available from Internet: < URL: http://www.cn.ca/documents/WhitePapers/Transporting-Wind-Turbines-White-Paper-en.pdf>

Environics Research Group (2010). *Prospects of the Renewable Energy Sector in Egypt Focus on Photovoltaics and Wind Energy* [online]. Cairo, Egypt: Egyptian-German Private Sector Development Programme. Available from Internet: < URL: http://www.jcee-eg.net/download.asp?path=library/PSDP%20Egypt%20RET%20Final%20Report.pdf >

Enzili, Mustapha, Nayysa, Abdelmoula, Affani, Fathallah & Simonis, Philippe (1988). *Wind Energy in Morocco Potential - State of the Art – Perspectives [online]*. Marrakech, Morocco: CDER. Available from Internet: < URL: http://www.dewi.de/dewi/fileadmin/pdf/publications/Magazin_12/07.pdf>

Fried ,Lauha, Shukla, Shruti & Sawyer, Steve (2012). *Global Wind Report, Annual Market Update 2011* [online]. Brussels, Belgium: Global Wind Energy Council (GWEC). Available from Internet: < URL: http://www.gwec.net/fileadmin/documents/NewsDocuments/Annual_report_2011_lowres.pdf>

He, Yulin & Chen, Xinping (2009). *Wind turbine generator systems. The supply chain in China: Status and problems* [online] 34: 21. Journal of Renewable Energy. Available from Internet :< URL: http://www.sciencedirect.com/science/article/pii/S0960148109001190 >

Ianchovichina, Elena, Mottaghi, Lili, Wood, Christina A, Loening, Josef & Savescu, Christina (2011). *World Bank Middle East and North Africa Region, Regional Economic Update May 2011, MENA Facing Challenges and Opportunities* [online]. Washington, United State of America: The World Bank. Available from Internet: <URL: http://siteresources.worldbank.org/MENAEXT/Resources/EDP_MNA_2011.pdf>

Junfeng, Li, Pengfei, Shi & Hu, Gao (2010). *China Wind Power Outlook 201* [online]. Scenario by: Chinese Renewable Energy Industries Association, Global Wind Energy Council (GWEC) & Greenpeace International. Available from Internet: <URL: http://www.gwec.net/fileadmin/documents/test2/wind%20report0919.pdf>

Kaldellis, John K & Zafirakis, D (2011). *The wind energy (r)evolution: A short review of a long history* [online] 36: 7. Journal of Renewable Energy. Available from Internet: < URL: http://www.sciencedirect.com.proxy.tritonia.fi/science/article/pii/S0960148111000085>

Mack, Natasha, Woodsong, Cynthia, MacQueen, Kathleen M, Guest, Greg & Namey, Emily (2005). *Qualitative Research Methods: A DATA COLLECTOR'S FIELD GUIDE* [online]. North Carolina, United States of America: Family Health International. Available from Internet: < URL http://fhi.org/NR/rdonlyres/emgox4xpcoyrysqspsgy5ww6mq7v4e44etd6toiejyxalhbmk5sdnef7fqlr3q6hlwa2ttj5524xbn/datacollectorguideenrh.pdf>. ISBN 0-939704-98-6.

Maylor, Harvey & Blackmon, Kate (2005). *Researching Business and Management.* 2nd Ed. Hampshire: Palgrave Macmillan Ltd. 453 p.

Mortensen, Niels G, Said, Usama & Badger, Jake (2005). *Wind Atlas for Egypt* [online]. Roskilde, Denmark: Risø National Laboratory, Cairo, Egypt: New and Renewable Energy Authority. Available from Internet: < URL: http://www.windatlas.dk/egypt/download/wind%20atlas%20for%20egypt%20paper%20(menarec3).pdf>

New & Renewable Energy Authority (NERA) (2005). STRATEGY & MANDATE [online]. Available from the Internet: <URL http://www.nrea.gov.eg/english1.html>

Organization of the Petroleum Exporting Countries (OPEC). Home, Data / Graphs, OPEC Oil Reserves, OPEC Share of World Crude Oil Reserves [online]. Available from the Internet: <URL http://www.opec.org/opec_web/en/data_graphs/330.htm>

Pullen, Angelika & Eneland, Meera (2006). *Global Wind 2006 Report* [online]. Brussels, Belgium: Global Wind Energy Council (GWEC). Available from Internet: < URL: http:// http://www.gwec.net/fileadmin/documents/Publications/gwec-2006_final_01.pdf>

Pullen, Angelika, Hays, Keith & Knolle, Gesine (2009). *WIND ENERGY - THE FACTS PART IV INDUSTRY AND MARKETS* [online]. Brussels, Belgium: The European Wind Energy Association (EWEA). Available from Internet: < URL: http://www.wind-energy-the-facts.org/documents/download/Chapter4.pdf>

Pullen, Angelika, Sawyer, Steve, Teske, Sven & Jones, Jackie (2010). *Global Wind Energy Outlook 2010* [online]. Scenario by: GWEC, Greenpeace International, DLR & Ecofys. Available from Internet: < URL: http://www.gwec.net/fileadmin/documents/Publications/GWEO%202010%20final.pdf>

Pullen, Angelika & Sawyer, Steve (2011). *Global Wind Report, Annual Market Update 2010* [online]. Brussels, Belgium: Global Wind Energy Council (GWEC). Available from Internet: < URL: http://www.gwec.net/fileadmin/images/Publications/GWEC_annual_market_update_2010_-_2nd_edition_April_2011.pdf>

U.S. Energy Information Administration (2011). *International Energy Outlook 2010* [online] 292 p. Washington DC, United states of America: U.S. Energy Information Administration, Office of Integrated Analysis and Forecasting. Available from Internet: < URL: http://www.eia.gov/forecasts/ieo/pdf/0484(2011).pdf>

U.S. Energy Information Administration (2011). *Liquid fuels production in Middle Eastern and North African countries* [online]. Available from the Internet: <URL http:// http://www.eia.gov/todayinenergy/detail.cfm?id=690 >

U.S. Energy Information Administration (2012). *Country Analysis Briefs- Egypt* [online] 9 p. Available from the Internet: <URL http://www.eia.gov/EMEU/cabs/Egyp<URL t/pdf.pdf>

U.S. Energy Information Administration (2012). *Country Analysis Briefs-Iran* [online] 13p. Available from the Internet: <URL http://205.254.135.7/EMEU/cabs/Iran/pdf.pdf>

U.S. Energy Information Administration (EIA). International Energy Statistics, Petroleum, Consumption [online]. Available from the Internet: <URL http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=5&aid=2&cid=AG,BA,EG,IR,IZ,IS,JO,KU,LE,LY,MO,MU,QA,SA,SU,SY,TS,TC,YM,&syid=2005&eyid=2010&unit=TBPD>

World Wind Energy Association (WWEA) (2011). *Half-Year Report 201* [online]. Available from the Internet: <URL: http://www.wwindea.org/home/images/stories/publications/half_year_report_2011_wwea.pdf>

World Wind Energy Association (WWEA) (2011). Information on the Region [online]. Available from the Internet: <URL: http://www.wwec2011.net/content/information-region>

Yin, R. K. (1994). Case Study Research: Design and Methods. 2 ed. California, Sage Publications.