Renewable Energy for Electricity Production in Pakistan: The Widespread Acceptance of Wind Energy

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Abstract

The research aims to have an insight into wind energy as a renewable source in the context of Pakistan and its electricity needs. It has pondered over the lack of technological advancement for electricity production in Pakistan by using wind energy. The research in this regard had acceptance of both quantitative and qualitative data to overcome the shortage of data existing in this regard. For the questionnaire survey conducted, a sample size of 125 employees from the energy sector was observed along with an interview of 5 managers being conducted. Results were first tested with PSS for the reliability and validity and correlation run to have an effective review for the data. Findings and conclusion suggest that surely the wind energy usage can allow Pakistan to overcome its energy deficient especially with electricity. Awareness, technology production and equipment like wind turbines all developed at a local scale can result in better chances for Pakistan to exploit wind energy.

Keywords: widespread wind energy usage, wind energy for electricity production in Pakistan, lack of awareness, localized production of wind turbines, reducing fluctuation with high tech batteries.

1 Introduction

Energy is considered as the basic source of the growth at the global scale. The electricity is required in every industry from manufacturing to travelling and transport. The increase in the competition at the global scale has been observed because of which electricity demand is increasing rapidly. However, due to more consumption of the electricity environment issues are raised. The citizens of the world are likely to switch to renewable sources as it helps them to make planet greener as an increase in the consumption also increased the usage of fossil fuel. As per the study of Haas et al. (2011), the changes in the world observed from the start of the 21st century and shift towards renewable energy is observed. The E.U. region was the one that started working on renewable sources which was further adopted by other countries as well. Government of multiple countries are also promoting the usage of renewable energy because of significant changes. The main reason to create awareness regarding renewable energy as it allows management to make a planet greener. Also, renewable sources fulfil the demand of the industries effectively and lead toward further development.

As per the study of Jentsch et al. (2014), renewable energy can be implemented in the structured format by the government as it affects positively on the environment and makes it cleaner. Further, the organization can perform operations with high tech by getting energy from a renewable source. In the view of Chaudhry et al. (2009), the organization in Pakistan invested in the research and development to perform operations with renewable energy. However, researcher's related to renewable energy is quite complicated. The rising needs of the country related to electricity lead towards renewable energy as it becomes the need. Further, the Pakistan government is also concerned about the environment as changes in the demand also increased the consumption of fossil fuel. From the past few years, it has been observed that in some are of Pakistan, and renewable energy is adopted by the citizens. Another aspect of the energy sources is highlighted by Khan and Pervaiz (2013), as Pakistan has a division for electricity production. The country is currently producing around 30% of energy from the hydropower. However, the management is working with some other source that includes coal-fired power plants and fossil fuel. Due to an increase in consumption needs, the management is working for the further development of energy sources.

The mentioned study mainly highlight the need for electricity in Pakistan. The deficit in electricity is one of the major problems that are faced by authorities.

The above mention framework has been derived from the study of Rehman (2019), which highlight the demand of consumer, distribution capacity of the government and deficit M.W. of electricity.

1.1 Research Aim and Objectives

The aim of the study is to considered renewable energy as a source for electricity production in Pakistan with

further focus on the widespread acceptance of wind energy.

Following research objectives shall be satisfied during the study:

- To understand the concept of renewable energy and various sources of renewable energy.
- To explore the current trends of using renewable energies in Pakistan energy sector.
- To evaluate the widespread usage of wind energy as renewable energy for electricity production in Pakistan.
- To make recommendations for adopting wind energy as a renewable source of electricity production in Pakistan.

1.1.1 Research Question

Following research questions have been extracted from the research objectives above and shall be answered during the course of the study:

- What are sources of renewable energy already deployed for electricity production within Pakistan?
- What are the potential benefits for deploying the use of wind energy for electricity production in Pakistan?
- What are the possible issues in using wind energy for increased production of electricity in Pakistan?
- What might be the areas that shall appraise the chances of accepting wind energy as a leading renewable source for electricity production?

1.2 Hypothesis

H_1: There is a significant contribution of Renewable energy for electricity production in Pakistan

H_0: There is no significant contribution of Renewable energy for electricity production in Pakistan

H_2: There is an impact of the betterment of awareness, apt storage and maintenance of supply and localized technology development of widespread acceptance wind energy in Pakistan.

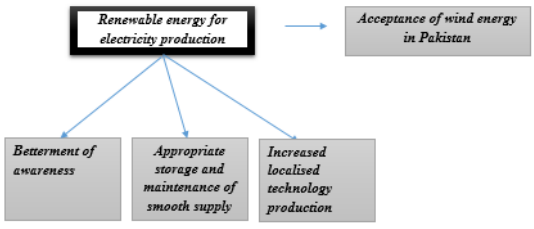
H_2: There is no impact of the betterment of awareness, apt storage and maintenance of supply and localized technology development of widespread acceptance wind energy in Pakistan.

H_3: There is a widespread acceptance of wind energy for electricity production in Pakistan

H_0: There is no widespread acceptance of wind energy for electricity production in Pakistan

1.2.1 Research Framework

The close link between the independent and the dependent variable becomes evident through then framework presented below:



2 Literature Review

2.1 Energy profile for Pakistan

The energy sector for Pakistan puts up quite a diverse portfolio for the electricity generation. Even with pressing concerns

over using fossil fuels to generate energy and electricity, Pakistan still derives nearly 80% of its energy using oils, gas and coal (Sarim, 2019). This further details over the fact that 20% of remaining encompasses the other diverse energy resources. Even as work is underway, just 2% of the total energy generated using renewable sources. The energy generation units have increased in number with the Government of Pakistan bent on reducing the electricity shortfall in the country.

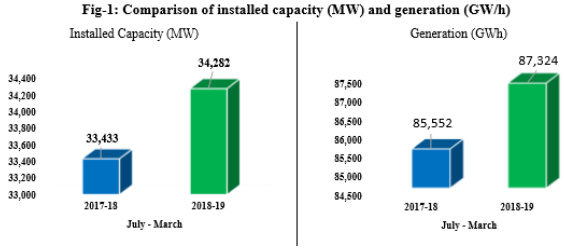


Figure 1: Comparative display of installed capacity (M.W.) vs Generation (G.W./h) (Ministry of Energy 2019)

Mentioned above is the statistical description of the installed capacity and the generation capacity for the country. Pakistan has observed a significant rise in its capacity produce electricity where the installed capacity in the year 2017-2018 was 33,433 Megawatt (M.W.), and the consequent generation capacity was 85,552 Gigawatt/hour (G.W/h). Yet this changed in the year 2018-2019 where installed capacity rose to 34,282 MW, and generation capacity was raised to 87,324 (Mistry of Energy, 2019).

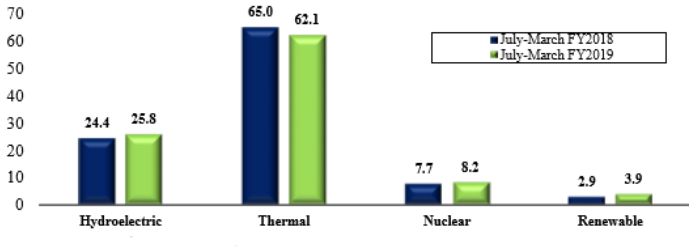


Figure 2: Energy resource-based division of electricity

Thermal energy being core for different pollutants with its consumption in energy generation witnessed a decline in the year 2019. The display of growth for other greener and renewable sources of energy to produce electricity is mentioned above. Provided in the report by Ministry of Energy (2019) thermal declined from a share of 65.0% in 2018 to 62.1% in the year 2019, the opposite came about for renewable (2.9% in 2018 and 3.9% in 2019) and nuclear energy (7.7% in 2018 and 8.2% in 2019).

2.2 Renewable energy for electricity generation in Pakistan

The renewable energy usage in electricity generation for Pakistan has recently witnessed a rise. With concerns as domestic and international temperature rise, the Government witnesses a pressure from the International community and as its own benefit to have electricity production switched to renewable energies. Unwin (2019) provide for findings where electricity generation from renewable sources is to reach 30% by the year 2030. This under the Government of Pakistan's goals for a sustainable electricity generation. A similar set of findings was presented by the World Wind Energy Association (2019). The report highlights a more numerically understandable reading for the 30% electricity generation from renewable

energy. Calculating it to be nearly 18,000 MW of electricity in Pakistan shall come from renewable sources. Such findings create a positive notion being generated for Pakistan on a global scale for climatic control and promoting sustainability.

2.3 Wind energy and the global scenario

The International Energy Agency (2019) provides for the fact that even as the world turns to renewable energy for electricity production, it is yet to sufficiently explore the potential that wind energy has for electricity production. The report highlights its readings for the capacity add-ons and the production increases from the wind energy is around is 12%. As per the changes in sources of renewable energy, wind energy potential has been observed. It is added that there is the potential of wind energy for energy production, but, it requires complete attention as a skilful person can perform an operation for wind energy effectively. The global trends of renewable energy are growing rapidly, and it requires continuous improvement. The presently available sources of renewable energy are 47 G.W., and it is estimated that till the year 2030 it will reach 108 GW.

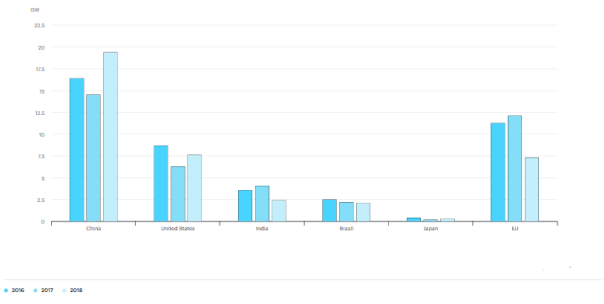


Figure 3: Country-wise distribution of Wind energy usage for electricity generation in 2017, 2018 and 2019 (International energy agency 2019)

The above mention graph highlights that there is variation in the installation of a wind energy plant at the global scale due to the acceptance factor. However, growth of the wind energy is quite important for the further development of the country, and it can be implemented effectively when authorities design complete structure for it.

2.4 Benefits of using wind energy in electricity production for Pakistan

The wind energy as a renewable source become the need of Pakistan because of the shortage issues. In the light of Pakistan Meteorological Department (2019), the department is working on the development of the energy sector and focus on researches related to wind energy and its benefit for further electricity generation in Pakistan. It is added by the department as per the result of the report, and it has been highlighted that wind energy farms have significant benefits. The benefit also impacts positively on the economy of Pakistan, which is majorly linked with the agriculture sector. In contrast, with other solar renewable energy, the management needs a larger space for that. Such as solar projects on the farm require land and space which they use to perform the purpose of the agriculture. However, it has been observed that tribunes when designed, it occupies around 2% of the land. After making the wind farms land, the farmers can get the benefit as they get paid for their land in patches which enhance their profitability and allow them to allocate resources effectively.

It has been witnessed in Pakistan, that further benefit which farmers get from the wind energy is it has zero carbon footprint. The wind energy is a one-time investment,

and it will provide long-term benefit, it does not require any kind fuel to perform operations further. This will help the authorities of Pakistan who is mainly working for the environment as it decreases the greenhouse emission by around 0.8 to 0.9 tons with each megawatt electricity that is produced. Greenhouse emission provides benefit to the overall economy of the country, and it reduces the cost of operations.

As per the study of Kamran et al. (2015), the secondary data has been derived which is based on the assumption on the real cost of capital and cash flows of two renewable energy sources which include thermal power and wind. To elaborate on the data, further information is added related to annual repayments and cost of capital. The table mention below shows production information with two selected energies and its cost of operations:

Cash flows (Rs. 000)	2008	2009–2013	2014–2016	2017	2018	201
Wind power	(782, 584)	(258, 628)	781, 030	254, 810	252, 154	2, 3
Cumulative	(782, 584)	(1041, 212)	(260, 182)	5, 372	246, 782	2, 6
Thermal power	(372, 587)	205, 093	106, 821	32, 951	32, 453	364
Cumulative	(372, 587)	(167, 494)	(60, 673)	(27, 722)	4, 731	369

It is further added that until the year 2028 to deduce wind farmer to be more effective for the country. In relation, to improve the overall system of agriculture the management can set criteria for return on investment as through this, shareholders are likely to invest money in the wind energy which makes sustainable operations in the agriculture sector(Kamal et al. 2015).

It is claimed by the researcher that proper implementation of wind energy in Pakistan provide multiple benefits, and it will reduce the cost of electricity nearly twice the current amount. Further, it affects positively on the environment as well as impact positively on the overall image of the country (Harijan et al., 2011). Climate Reality Project (2016), it is a myth that wind energy is costly as per the findings of the study, the operations of wind energy cost around 2.35 cents to generate electricity per kilowatt-hour. The management of Pakistan currently performing operations by importing the oil to run plants. But, it is added by the researcher that management can gain both environmental and economic benefits by using wind energy.

2.5 Challenges of using wind energy in electricity production for Pakistan

With multiple benefits, there are different challenges which will be faced by the management when they implement wind energy. As per the study of Baloch et al. (2016), the wind energy requires a huge amount of the cost for an initial start as well as to take benefits for long-run management need to perform maintenance operations which also require the invest. It is added, by the researcher that wind energy provides economic and environmental benefits. But, Pakistan economy is currently at a struggling stage to invest money at this stage will be difficult for the authorities. As per the study of Farooque et al. (2009), operations with the wind energy has been started in Pakistan but, still, there is a significant area of the room for growth with this specific renewable source. It has been observed that the government of Pakistan is also facing issues due to lack of technical staff as high-investment can go in vain if operations of the wind energy are not performed by staff member effectively. In terms of economy, it creates further issues for the government if the huge

investment does not provide expected benefits.

Asif (2009), the implementation of wind energy in the current stage of the country bring challenges for the management as there is a need for awareness first. The government need first to provide information regarding wind energy to the stakeholders as they are main investors. Pakistan, as the country does not recognize the potential of wind energy in the country due to which major challenges are faced by authorities while considering the wind energy as a solution. The wind energy requires proper planning as cost of implementation is quite high as well as this form of energy requires the technical staff who have the specific skillset to allocate resource for wind energy effectively. Thus, it is considered a challenge that management is currently working at the awareness of wind energy as before acceptance of the energy implementation can raise further challenges.

3 Research Methodology

The methodology of the study has been considered by the researcher to complete the objectives of the study in an aligned manner and select the appropriate technique to fulfil the requirement of data collection. In the view of Kumar (2019), the approach of the study is considered as it is important to gather information for the study. The two main approaches for the study include inductive and deductive. The inductive approach is selected when researchers work on the simple observation and work further on it. In the inductive approach, researchers design new theory and in the end, work on hypothesis. In the current study, the researcher has been used deductive approach for the study as the concept of wind energy is existing. The researcher designed the hypothesis to highlight the relationship between the variables. The researcher gains knowledge from the primary source as it allows the researcher to collect more specific information and fulfil the requirement of the topic effectively.

In the view of Flick (2015), the research design is considered to describe the logical positioning of different component of the study. Two common research design are explanatory, descriptive and exploratory. In the current study, the researcher has been used explanatory design to highlight the findings effectively as it allows the researcher to define the relationship among variables. The researcher further adds more recent information related to the topic which fulfils the gap and enhances the knowledge in a specific field. The researcher has been considered positivism philosophy as information is gathered in a numeric form which is one of the requirements of the selected philosophy. Further, the researcher also gathered quantitative data as it helps the researcher to support primary findings and conclude the result of the study effectively. Two of the common techniques which are being considered by the researcher is qualitative and quantitative. In some case, researchers used both techniques together, which is known as a mixed technique of the study. The researcher has been adopted a mixed technique of the study as it allows the researcher to fulfil the need for objectives and techniques appropriately. With the help of quantitative technique, the researcher gain information from respondents of the survey and to fulfil

qualitative requirement data has been gathered from prior studies and interviews.

Further, the researcher adopted two strategies to complete the study effectively as it fulfils the requirement of selected philosophy as well. The researcher has been used as a survey to gather information from a large number of people in a limited time period. However, ethnography has been used to conduct a detailed interview from the experts of the field. Moreover, information has been derived from both sources, primary and secondary. The primary source of data allows the researcher to gather more specific information. On the other hand, with the help of a secondary source, the researcher is able to understand the topic effectively as well as it further supports primary information. The sample size and sample technique both are considered by the researcher as it contributes to data collection. The researcher gathered questionnaire information from 125 respondents for a survey and used convenience technique of non-probability sampling. The researcher gathered information from five managers for an interview and adopted sampling technique is a snowball.

1 Discussion and Findings

1.1 Statistical Test

The statistical test has been conducted to analyses the collected data more effectively as well as to measure the impact of variables on each other.

Reliability

Reliability Statistics

Cronbach's Alpha	N of Items
.923	10

The reliability statistics is considered as it is the main pillar which allows the researcher to conduct a further test on primary data. If the value of Cronbach alpha is less than 0.50, the researcher needs to gather complete data of study again. However, in the current study scenario, the value of Cronbach alpha is 0.923, which indicates that data of the study is highly reliable.

Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.798[a]	.637	.628	.32076

a. Predictors: (Constant), IncreasedLocalizedTechnologyProduction, BettermentOfAwareness, AppropriateStorageAndMaintenanceOfSmoothSupply

The variation in the dependent as per statistical test is 63.7% which has been derived from the above mention table. However, the estimated error is around 0.320.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.867	3	7.289	70.847	.000[b]
	Residual	12.449	121	.103		
	Total	34.316	124			

a. Dependent Variable: AcceptanceOfWindEnergyInPakistan

b. Predictors: (Constant), IncreasedLocalizedTechnologyProduction, BettermentOfAwareness, AppropriateStorageAndMaintenanceOfSmoothSupply

The data of the study is highly significant because the sig value is 0.00, which is less than 0.05.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	.687	.080	
	BettermentOfAwareness	.057	.028	.129
	AppropriateStorageAndMaintenanceOfSmoothSupply	.302	.033	.634
	IncreasedLocalizedTechnologyProduction	.076	.029	.163

a. Dependent Variable: AcceptanceOfWindEnergyInPakistan

From the above table of the study, the value of the coefficient has been derived, which further help the researcher to derive the equation of regression.

$$Y \text{ (Dependent variable)} = \beta + \beta_1 \text{ (Independent variable)} + \beta_2 \text{ (Independent variable (Independent variable)} + e$$

Regression equation of the current study is mentioned below as it create better understand regarding the dependent and independent variables of the study:

Y (Acceptance of wind energy in Pakistan) = $\beta + \beta_1$ (Betterment of Awareness) + β_2 (Appropriate storage and maintenance of smooth supply) + β_3 (Increased localized technology production) + e

Y (Acceptance of wind energy in Pakistan) = $\beta + \beta_1$ (0.057) + β_2 (0.302) + β_3 (0.076) + 0.080

Correlation

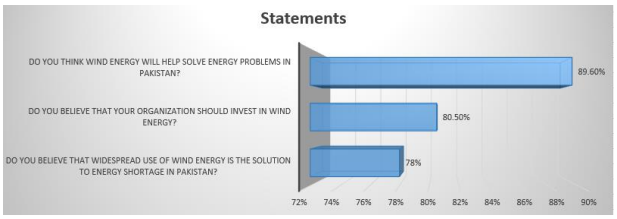
Correlations

		AcceptanceOfWindEnergyInPakistan	BettermentOfAwareness	AppropriateStorageAndMaintenanceOfSmoothSupply	IncreasedLocalizedTechnologyProduction
AcceptanceOfWindEnergyInPakistan	Pearson Correlation	1	.490**	.776**	.502**
	Sig. (2-tailed)		.000	.000	.000
	N	125	125	125	125
BettermentOfAwareness	Pearson Correlation	.490**	1	.497**	.280**
	Sig. (2-tailed)	.000		.000	.002
	N	125	125	125	125
AppropriateStorageAndMaintenanceOfSmoothSupply	Pearson Correlation	.776**	.497**	1	.479**
	Sig. (2-tailed)	.000	.000		.000
	N	125	125	125	125
IncreasedLocalizedTechnologyProduction	Pearson Correlation	.502**	.280**	.479**	1
	Sig. (2-tailed)	.000	.002	.000	
	N	125	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).

With the help of the above table, the researcher gained information regarding the relationship among the variables. It has been derived that Betterment of awareness has a strong relationship with the wind energy acceptance in Pakistan as derived value is 0.490, which is more than 0.05. Further, appropriate storage and maintenance of smooth supply and increased localized technology production both variables have an impact on the dependent variables of the study.

Findings



Findings from the survey highlight a very large number of the employees to believe that Yes, wind energy can be the potential solution to the inevitable energy shortage coming Pakistan's way. While 89.60% of the respondents have dwelt over the agreement with wind energy being the solution to Pakistan's energy problems, trends from the interviews conducted are a bit different. Responses from the managers such as that by Manager A:

"*I believe that we as Pakistanis are still quite under-informed for renewable energies. Trends for renewable energy for electricity production are slow and need to be worked upon.*"

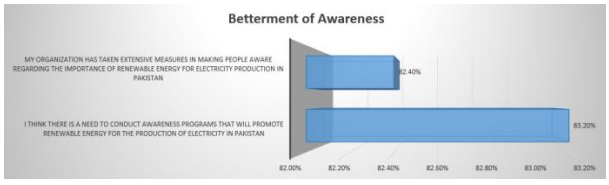
While employee awareness being quite high as observed in the graph above, managerial level belief suggests that Pakistan is yet to know how effective wind energy can be for electricity production. The literary analysis in the sections above suggests that awareness for renewable energy as a whole is quite high, even if one is to observe regardless of focusing on the

wind to be specif. goal setting is already in place of the year 2030 where 30% of the energy needs shall be met using renewable energy resources (World Wind Energy Association, 2019). This gains support from the survey results where responses rate for the wind to be a solution for the electricity outage reaches 78% is considered an important factor for the awareness within the populous related to not just wind but renewable energy on the whole. It has been considered within the interviews that:

Manager C: "*The energy generation from renewable sources in Pakistan is still infant, trends, in my opinion, are still not considerable and require to be worked with greater effectiveness. I believe we are just producing about 2 – 3% of our electricity from renewable sources. The rest is all conventional."*

This provides support that even as some of the specialist energy sector-related population might know the effectiveness of renewable forms of energy, a wider market is yet to know of its effectiveness.

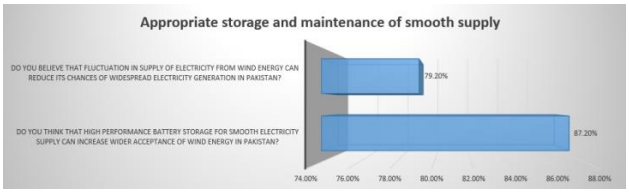
Betterment of Awareness



The belief prevails within questionnaire respondents that while their organization has undertaken the responsibility to make people aware of then uses wind energy can bring, in the long run, it still is quite small in scale. The betterment of awareness amongst the populous is to be the major factor that would drive wind energy usage in Pakistan to a larger scale. The response rate for agreement in relation to the fact that there still remains a need to initiate awareness programs for wind energy in the electricity generation for Pakistan was nearly 83.20% in agreement. This remarks industry-specific knowledge to be very strong for this. Using the interview-based responses, where the very first manager, when asked for lack of acceptance for wind energy at a wider scale in Pakistan, found that:

"*I find the lack of awareness within the energy sector to be quite important for the reduced use of wind energy within the country. Things have been more focused on solar energy rather than providing due to importance to wind energy as well.*"

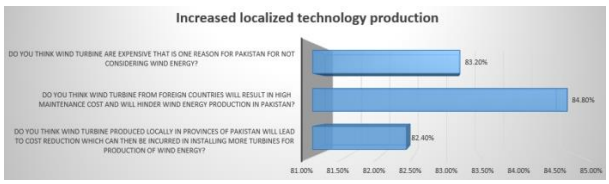
More of the managers also believed the same to be the cause that reduced effective implementation of wind farms in the country. This lack of awareness is comparative to that of the solar which is now widely recognized across the country from technical person to layman as well. So one must clearly see that even as the survey highlights a high number of responses i.e. 82.40% to remark that the organization are indulged in the awareness programs for wind energy, it is yet to reach the efficiency levels where the Government of Pakistan has the same number of investors as solar or hydro energy electricity. This it may be considered that awareness if spread across the country can result in wider acceptance of wind energy in Pakistan.



As a part of the findings, it remains effective to explain the concept of storage. Electricity storage in batteries which is the very basic aspect covered during the appropriate storage and maintenance of smooth supply within this research. This based on increased fluctuation as a result of using wind energy to generate electricity. With nearly 79.205 of the respondents showing agreement that fluctuation which is frequent in using wind energy for electricity generation limits its potential to have a larger share in Pakistan's electricity generation. The same has been observed with the managers and their respondents to the interview where a manager can be quoted:

"*Wind can be a very effective renewable source of energy for Pakistan especially in electricity development but as a country, we have reduced options for maintaining smooth supply and unlike solar energy stored in batteries, wind energy is yet to witness any such technology.*"

The next part of the survey suggested that would high-performance batteries developed at a larger scale and deployed alongside the turbines could have an impact on using wind energy as it would; help maintain better energy supplies. The response rate was nearly 87.20%. This highlighted significant homogeneity that wind although has a lot of potential in wider usage to produce electricity, it is yet to have technological assistance that could reduce the amount of fluctuation and thus allow a smoother supply of energy.



Costs are bound to reduce with localized production of equipment and technology for anything that is being imported. The same was sought in case of the wind energy for electricity generation, thus it has been considered that that use of wind energy if it is to be observed at wider scale in electricity generation for Pakistan, it would require the wider generation of wind energy technology at a local scale. 84.80% respondents' trend towards an agreement that yes it would be very costly to have wind turbines imported from the foreign countries. The respondents do not just believe that import but the maintenance of these imported wind turbines and other equipment shall put the costs to rise significantly. 82.40% of the response rate agrees to have locally produced technology developed for wind energy. This has been the case where solar panels manufactured at the local scale have brought better usage of solar power. The same can be extracted from the fact that electricity production from wind energy as it's commonly considered quite expensive can break past this false news as localized wind turbines will be cheaper to maintain and produce as compared to their imported counterparts. An 83.20% response rate for an agreement that Pakistan has been reluctant in using wind energy at a larger scale is surely the case of the high cost of erecting wind farms that use imported wind turbines. Manager B was found to state that:

"Our dependence on international produced technology of wind turbines is the major reason that wind energy in Pakistan becomes a costly renewable source for us."

Sources of secondary data like Harijan et al. (2011) and that of Jentsch et al. (2014) may be considered supportive of the findings from the primary data mentioned above. Where the research by Harijan et al. (2011) sheds lights over the fact that it is truly important that Pakistan rises above in the renewable energy sources to be used for power generation. On the other hand, the second research was more bent on storage of electricity in batteries which was to complement the usage of high tech batteries to reduce fluctuation of electricity from wind energy.

Conclusion

Benefits both environmental and economic can be conclusively mentioned as the widespread acceptance of wind energy in Pakistan is observed. It has emerged quite positively within the research that wind energy, on the whole, is a renewable source which shall never deplete, yet the mechanisms of cost and Rate of Return are to be the fact which would lead to the widespread acceptance and the limitations in its usage. The same has been the very purpose of the research. In this regard, findings have highlighted that surely the widespread acceptance of wind energy shall be based on the three factors: lack of awareness when transformed into wider knowledge of wind energy, reduced imported technology and increased localized production of the wind turbines with optimal quality standards in focus. Furthermore, it has been considered within the research that where Pakistan has been investing in increasing the proportion of using renewable energies it must have the relevant amount used to spread awareness in energies other than solar especially for wind. This would also have technological esearches expand the feasibility of wind energy a sources of electricity generation in Pakistan at wide scale. It can thus be concluded that the use of wind energy in electricity production for Pakistan can surely be beneficial yet it requires effective homework and setting the stage before its wider acceptance is invested in. Adding wind energy as a renewable source of energy in electricity production for Pakistan can have an overall impact on diversifying the energy portfolio further as well as having better impact on its attempts to reduce conventional fossil fuel based energies.

4 References

Asif, M. (2009). Sustainable energy options for Pakistan. *Renewable and Sustainable Energy Reviews*, *13*(4), 903-909.

Baloch, M.H., Kaloi, G.S. and Memon, Z.A., 2016. Current scenario of the wind energy in Pakistan challenges and future perspectives: A case study. *Energy Reports*, *2*, 201-210.

Chaudhry, M. A., Raza, R., & Hayat, S. A. (2009). Renewable energy technologies in Pakistan: prospects and challenges. *Renewable and Sustainable Energy Reviews*, *13*(6-7), 1657-1662.

Farooque, M., Javed, M. T., Khan, N. A., & Waheed, K. (2009). Challenges and opportunities for wind power

for future energy supplies in Pakistan. *Nucleus*, *46*(3), 253-262.

Flick, U. (2015). *Introducing research methodology: A beginner's guide to doing a research project*. Sage.

Haas, R., Panzer, C., Resch, G., Ragwitz, M., Reece, G., & Held, A. (2011). A historical review of promotion strategies for electricity from renewable energy sources in E.U. countries. *Renewable and sustainable energy reviews*, *15*(2), 1003-1034.

Harijan, K., Uqaili, M. A., Memon, M., & Mirza, U. K. (2011). Forecasting the diffusion of wind power in Pakistan. *Energy*, *36*(10), 6068-6073.

Jentsch, M., Trost, T., & Sterner, M. (2014). Optimal use of power-to-gas energy storage systems in an 85% renewable energy scenario. *Energy Procedia*, *46*, 254-261.

Kamran, M. (2018). Current status and future success of renewable energy in Pakistan. *Renewable and Sustainable Energy Reviews*, *82*, 609-617.

Khan, H. A., & Pervaiz, S. (2013). Technological review on solar P.V. in Pakistan: Scope, practices and recommendations for optimized system design. *Renewable and Sustainable Energy Reviews*, *23*, 147-154.

Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners*. Sage Publications Limited.

Ministry of Energy (2019). Pakistan Economic Survey 2018-19-Energy. Retrieved from < http://www.finance.gov.pk/survey/chapters_19/14-Energy.pdf >

Pakistan Meteorological Department (2019). Why wind energy?. Retrieved from <http://www.pmd.gov.pk/wind/Wind_Project_files/Page767.html >

Rehman, M. (2019). Pakistan's electricity generation has increased over time. So why do we still not have uninterrupted supply? Retrieved from < https://www.dawn.com/news/1430728 >

Unwin, J. (2019). What does Pakistan’s energy mix look like and what is its future?. Retrieved from < https://www.power-technology.com/features/pakistan-energy-mix/ >

World Wind Energy Association (2019). Pakistan to Set 30% plus 30% Renewable Energy Target by 2030. Retrieved from < https://wwindea.org/blog/2019/04/02/pakistan-to-set-30-plus-30-renewable-energy-target-by-2030/ >

5 Appendix

5.1 Questionnaire Survey

Questionnaire				
Demographics				
Department				
Field Engineering		Sales and Marketing	Finance	
Experience				
1 – 2 years	3 - 4 years	5 - 6 years	7+	
Statements				
Does the idea of generating your own electricity apply significantly to your organization and its strategies?				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you believe that your organization should invest in wind energy?				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you thinkwind energy will help solve energy problems in Pakistan?				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Betterment of Awareness				
I think there is a need to conduct awareness programs that will promote renewable energy for the production of electricity in Pakistan				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
My organization has taken extensive measures in making people aware of the importance of renewable energy for electricity production in Pakistan				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Appropriate storage and maintenance of smooth supply				
Do you think that high performance battery storage for smooth electricity supply can increase wider acceptance of wind energy in Pakistan?				

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you believe that fluctuation in supply of electricity from wind energy can reduce its chances of widespread electricity generation in Pakistan?				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Increased localized technology production				
Do you think wind turbine produced locally in provinces of Pakistan will lead to cost reduction which can then be incurred in installing more turbines for the production of wind energy?				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you think wind turbine from foreign countries will result in high maintenance cost and will hinder wind energy production in Pakistan?				
Yes		No		
Do you think the wind turbine is expensive that is one reason for Pakistan for not considering wind energy?				
Yes		No		

5.2 Interview Questions

- Please shed light on the current trends of using renewable energies in Pakistan energy sector.
- What are the reasons for lack of acceptance of wind energy in Pakistan?
- How organizations in your sector are working on promoting wind energy as a source of electricity production in Pakistan.
- How your organization has contributed to its role in promoting wind energy? Any restrictions of government are faced by you. Please elaborate.
- Wind energy is unlimited, free, and a best renewable resource to be preferred that leads to high economic returns if considered. To what extent you agree to this statement.