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# National Power Policies of Pakistan Concerning Global Trend toward Sustainable Energy and its Prospects

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***Abstract*****—** In this article, energy policies of Pakistan is weighed against efforts made by global community for sustainable energy. Comparison of the planning and its execution for green energy between Pakistan and other nation is discussed in detail. Pakistan is passing through a phase wherein the policy maker and executor are determined to overcome the shortfall of energy in country. Economic growth of nation is majorly relying on energy because of firm relation between energy consumption and gross domestic product. As the future of world in general and nation in particular is dependent on sustainable energy, therefore, the policies for energy generation should properly directed to ensure its sustainability. Future prospect of renewable energy in Pakistan, which is sustainable at large, have potential of 167.6 GW, is more enough to meet the energy demand of Pakistan. The goal set by United Nation to safeguard the sustainability of energy aiming to ensure the affordable, reliable and modern energy by 2030 for all has been discussed in detail. In compliance with these targets set by international community, the diversification of reliance on conventional energy resources and exploiting the naturally existing renewable energy is imperative to have a sustainable power development in Pakistan.

***Keywords*****—**Sustainability, Renewable Energy, Sustainable Development Goal, Efficiency, Policy, Levelized Cost of Energy.

## I. INTRODUCTION

Contemporary world is striving for green and sustainable energy owing to unavailability and exhausting conventional energy resources. Reliance on conventional energy, which repository is depleting day by day and remained the major source of emitting greenhouse gases, is becoming a real impetus to direct world toward the sustainable and clean energy. Demographic analysis shows a big portion of population is now settling in the uninhabited area such as deserts and mountainous because of the overpopulation. Access of reliable and affordable energy for those remote area's masses is remained a great challenge for the world. To fulfill the energy needs of this large number of inhabitants the world is now turning toward the renewable energy, which can easily installed and accessed [1]. The research work has been going in full zeal to overcome these problems and convert the energy generation from conventional energy to unconventional energy in very short period. Owing to exhausting conventional energy resources and demand of the present world in the context of ecological issues, the researcher are encouraged to explore the new, more efficient, green and environmental friendly ways of generating electrical energy using advance techniques [2]. As the concerns about the protection of environment is rising every day, the demand and hence the investigation and research on clean and new energy fuel is increasing with same pace. The new techniques adopted using renewable energy i.e. wind, tidal, micro hydro, biomass, geothermal and solar is advancing to fulfill the energy requirement of present world [3].

In this context, a systematic and determined effort is need on the global scale to ensure the better future of the coming generation and the planet where we live. United Nation has set seventeen different goals to pursue the sustainable future of the world without discrimination in different aspect. One of the major aspect of which is energy. After the successfully completion of period of Millennium Development Goal (2000-2015) which focus on the eradicating poverty from world, Sustainable Development Goals (SDGs) have been set for period of 2016 to 2030 encompass improvement of seventeen different world problems. One of the key problem upon which the other problems also relay is clean and affordable energy for all is part of these SDGs. Goal 7 defined as "Ensure access to affordable, reliable, sustainable and clean energy for all" contain three different targets to confirm access to sustainable, efficient and renewable energy for all. Each target has its own indicators to measure the progress in that target. Different agencies and organizations are working to accomplish these targets in stipulated time and measuring the progress made in each target according to the assign indicator.

According to the assessment organized by United Nation Development Program (UNDP), 1.7 billion people have made access to the electricity from 1990 to 2010, but still 13 percent of world population has no access to the clean energy. Sixty percent of the anthropogenic gases emission that cause climate change is because of the conventional energy that is not environmental friendly. If proper measure has taken in adopting of standard of efficiency, about 14 percent of global electricity

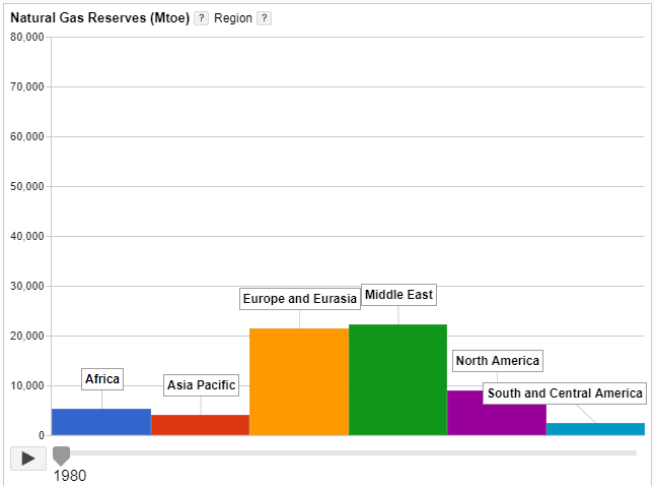
consumption can reduce. Forty percent or even more people are relaying on unhealthy cooking fuels that results in number of mortality particularly in house hold women. To avoid greenhouse gas renewable energy is the optimal option that is now making about 18 percent of share in global energy mix [4]. Similar work is also conducting by other different organization like International Renewable Energy Agency (IRENA), International Energy Agency (IEA) and different other agencies and organizations.

In this paper, analysis of different efforts, made nationally and internationally for sustainable energy, has been done. The standards that have been set internationally for ensuring sustainable energy and its evolution with time is examined and efforts made by different nation in this regard is scrutinized on the base the policies these nations have been made and the investment they have made and also the efficiency they improved. Again the same analysis of has been done and compare with the other nations to find the shortcoming and made proposition in this regard.

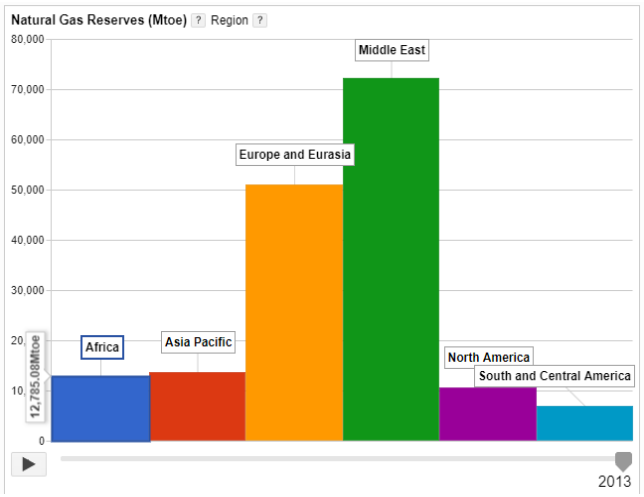
## II. SUSTAINABILITY AND AVAILABILIGY OF GREEN ENERGY

Energy having insignificant consumption when compare with its supply is generally sustainable. Sustainable energy fulfil the energy demand of present world without jeopardizing the energy needs of future generation. Sustainability of energy resources is not only concerned with the length of its life period but also entailed the affordability, cost effectiveness and its impact on the environment and ecosystem of the planet. On the other hand, renewable energy are that which replenish after specific period of time which refilling time is less than its consumption time. Renewable energy resources that can satisfy human energy need is majorly comprises of Wind Power, Solar power, Hydro power, Geothermal and Tidal and Wave power. Owing to this, all the renewable energy is not sustainable and vice versa. For sustainability, cost effectiveness and environmental friendliness is an important parameter.

Conventional energy resources such as fossil fuel and coal are presently using for generating a large portion of global energy and reached to its mature level but as it is not replenishing so the repository of these resources are deemed depleting in near future if energy generation is constantly relay on these resources. However, the natural gas has still long time to exhaust completely as new repository had been discovered in last few decades fig 1 [5]. However, natural gas is not renewable but because of its environmental friendly feature and its abundance, it is taken for sustainable energy. Same is the case with nuclear energy, the rich resources of uranium and cleanliness brought it in the list of sustainable energy though still debate is continue in this regard. Contrary to this, the geothermal energy, which is renewable energy, is not consider as sustainable as it has require large sum of cost to extract it from the earth. Nevertheless, recent development in the technology is taking it in the list of sustainable energy.




(a)




(b)

Fig.1: a) natural gas reserves (Mteo) in 1980 in different areas of world. b) natural gas reserves (Mteo) in 2013

Access to affordable and clean energy is real achievement that ensure the enhancement of economic growth, environmental sustainability and human development. After the adoption of SDG 7 in general and target 7.1 in particular, access to modern clean and cheap energy is becoming a reality in near future. Combining improved technology with decentralized and cheap renewable energy open the door for people of remote area to start their own business and cater different problem because of the access to the electricity. Approach to clean cooking energy is still needs a serious effort to avoid mortality and make the environment free of $CO^2$ and other anthropogenic gases.

1.2 billion people most of which are from developing Asian countries has achieved the access to electricity from 2000 to 2016 and left about 1.1 billion people without access fig[6]. The efficiency of the appliances used in houses play a vital role in reduction of energy consumption and thus save the investment cost of energy services. The energy saved can be used by others customers and thus provide opportunity to have access to many.

The affordability is can be also enhance by increasing the efficiency of equipment used in homes as well as in industries.

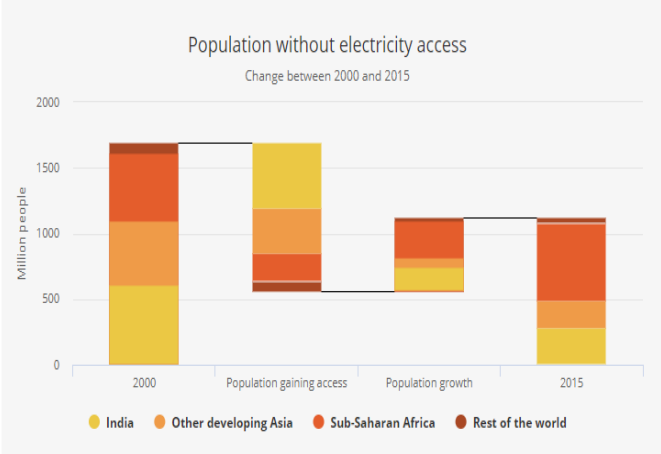



Fig.2. Number of People without access to Electricity

Among 1.2 billion people a large portion of 70 percent people are connected to the national grid that have been provided energy using fossil fuel but now, as the cost of renewable energy resources is declining day by day and efficiency improvement owing to technological advancement, the trend has turned toward isolated off-grid and mini-grid power system. This shift toward the cheap and clean energy system is expecting to expedite the process of awarding access to affordable and clean energy for all. In last five years about one third of fresh connection are made possible through hydro, solar, geothermal and other renewable decentralized sources.
Large portion of world population (estimated about 2.5 billion) is relying on traditional solid biomass for cooking their food. About 2.8 billion world population has no access to clean cooking means. Approximately 0.12 billion people burn kerosene oil and0.17 billion use coal for their daily use. Since, the global community has started the struggle to bring awareness among the mass and invested heavily to have an easy access to clean energy such as liquefied petroleum gas (LPG), electricity and natural gas, the large portion of world population is now using clean energy. Large portion of world population (estimated about 2.5 billion) is relying on traditional solid biomass for cooking their food. About 2.8 billion world population has no access to clean cooking means. Owing to population blast in certain area of the world still people is relying on solid biomass for cooking purpose and the number is increase to 0.4 billion causing serious health problems. Around 1.65 billion people in developing Asia is dependent on solid biomass for cooking which is 43% of the population. 600 million people that was dependent on kerosene and coal is now decline to 160 million due to switching to liquefied petroleum gas, electricity and gas. The masses is now getting aware of the threat of pollution resulting from burning unclean biomass and turning toward clean cooking fuels.

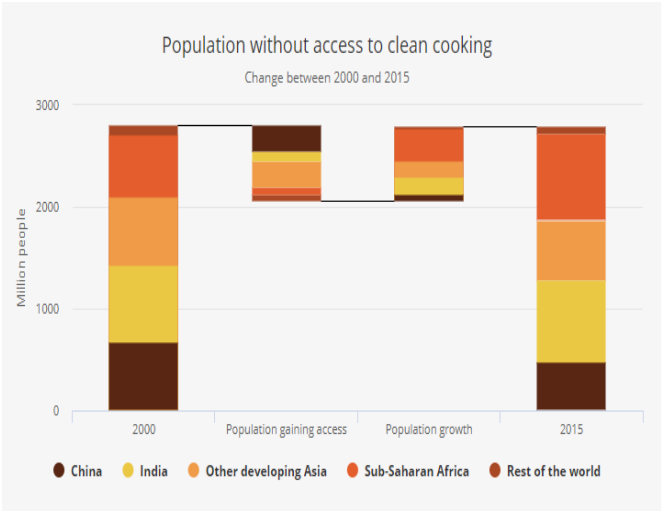



Fig.3. Number of People without access to Clean Cooking Fuels

## III. SUSTAINABLE DEVELOPMENT GOALS:

After the successfully completion of period of Millennium Development Goal (2000-2015) which focus on the eradicating poverty from world, Sustainable Development Goals (SDGs) have been set for period of 2016 to 2030 encompass improvement of seventeen different world problems. One of the key problem upon which the other problems also relay is clean and affordable energy for all is part of these SDGs. Goal 7 defined as "Ensure access to affordable, reliable, sustainable and clean energy for all" contain three different targets to confirm access to sustainable, efficient and renewable energy for all. Each target has its own indicators to measure the progress in that target. Different agencies and organizations are working to accomplish these targets in stipulated time and measuring the progress made in each target according to the assign indicator.

According to the assessment organized by United Nation Development Program (UNDP), 1.7 billion people have made access to the electricity from 1990 to 2010, but still 13 percent of world population has no access to the clean energy. Sixty percent of the anthropogenic gases emission that cause climate change is because of the conventional energy that is not environmental friendly. If proper measure has taken in adopting of standard of efficiency, about 14 percent of global electricity consumption can reduce. Forty percent or even more people are relaying on unhealthy cooking fuels that results in number of mortality particularly in house hold women. To avoid greenhouse gas renewable energy is the optimal option that is now making about 18 percent of share in global energy mix [7].

Each SDG has assign a set of specific targets and each target has its indicator to measure the progress in that target. The goal 7 that related to affordable and sustainable energy has three main targets and four indicators. Each target and its indicator are explain along with progress made until now. The data has be estimated and compiled by different agencies and organizations

*A. 7.1 by 2030 ensure universal access to affordable, reliable, and modern energy services*

This target has two indicator to measure its progress,

*1) Rate of primary energy intensity improvement.*

*2) Share of the population using reliable electricity, by urban/rural*

The target aimed to ensure the access to clean and modern energy for cooking and lighting their house and running their business for their livelihood of people, which are remained deprived of this basic amenity. The solid fossil fuel for cooking should be replace by stove running by clean energy to ensure safety and clean environment. According to WHO estimation, about 4 million people (majorly women) prematurely die owing to air pollution that emit from cooking solid biomass fuel. Among 1.2 billion people a large portion of 70 percent people are connected to the national grid that have been provided energy using fossil fuel but now, as the cost of renewable energy resources is declining day by day and efficiency improvement owing to technological advancement, the trend has turned toward isolated off-grid and mini-grid power system. According to IEA report, only 54% of people of the world is relied on clean energy in 2000 that raised to 62% in 2015. While in Pakistan, the access to clean energy for cooking was 20% in 2000 that raise to 50% in 2015 shown in fig. 4.

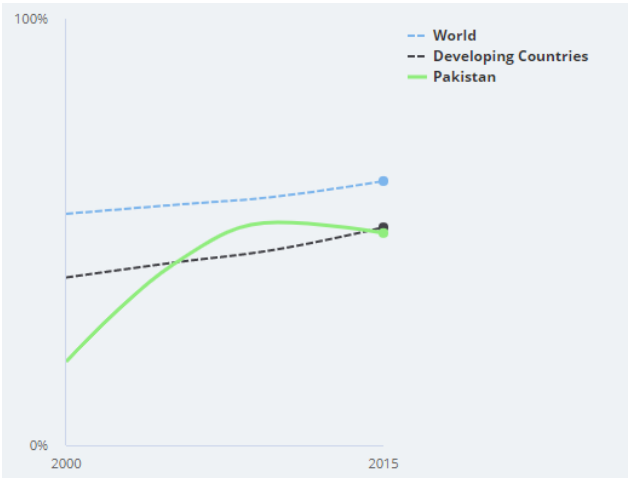



Fig.4. Percentage of population access to Clean Cooking Facilities in World, Developing Countries and Pakistan.

The population that has access to the clean and reliable energy is raised up to 86% in 2016 where 82% of the developing countries population has access to the energy which was 73% and 64% respectively in 2000. The access to electricity in Pakistan raised for 53% in 2000 to 74% in 2016 shown in Fig 5 [8].

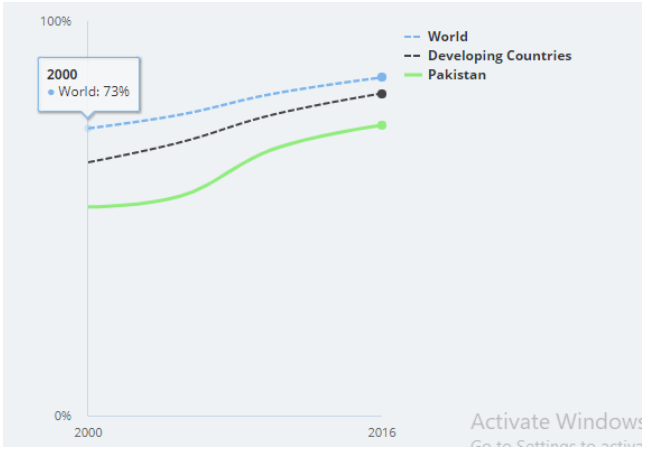



Fig.5. Percentage of population access to Electricity in World, Developing Countries and Pakistan.

*B. 7.2 increase substantially the share of renewable energy in the global energy mix by 2030.*

The indicator for this target is

*Implicit incentives for low-carbon energy in the electricity sector*

The target aimed to reduce the anthropogenic gas and carbon emission harming the environment that cause climate change. This target can be achieved by using renewable energy that ensure the safety of environment from carbon dioxide. The global community is now preferring to install new power plant that are based on renewable energy resources such as solar, wind and other such replenishing sources to save the environment from greenhouse gases. The share of modern renewable energy in the total energy mix of word was 7.4% in 2000 that is raised to 9.7% in 2016. While in Pakistan the share of modern renewable was 7.6% and now it is about 8% shown if fig. 6.

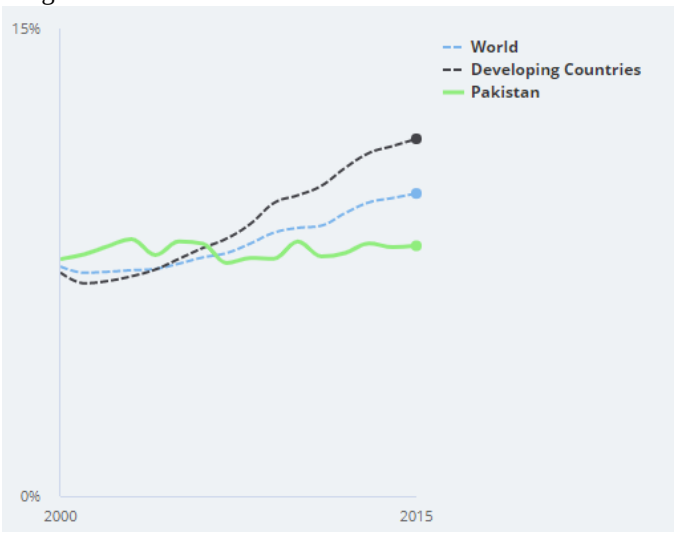



Fig.6. Percentage modern energy share in total final energy consumption of World, Developing Countries and Pakistan.

### C. 7.3: By 2030, double the global rate of improvement in energy efficiency

The indicator for this target is

*Rate of primary energy intensity improvement*

This target is actually about the energy efficiency which the proxy for energy intensity improvement. The energy intensity is the ratio of gross energy consumption to the GDP of that country.

Energy efficiency = Gross inland energy consumption/ Gross Domestic Product

The energy intensity rate of world in 2000 was 0.163toe/USD1000, which is then in 2015 0.131toe/USD1000. In case of Pakistan the energy intensity rate in 2000 is 0.134toe/USD1000 that is about 0.108toe/USD1000 in 2015 fig.7.

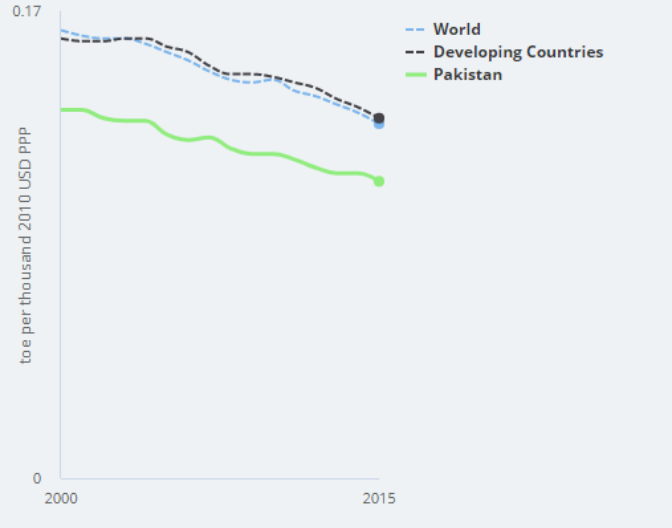



Fig.6. Energy Intensity Measure in term of primary energy of World,

## IV. Struggle of Different Nation toward Sustainable Energy

To ensure the sustainability in the energy sector, worldwide effort is going on and different nation has set the aims to opt for specific percentage of renewable and alternate energy in order to save the future generation from energy dearth. Developed Nations whose existing energy demand is satisfied by using fossil fuel but the reservoirs of the energy resources are depleting day by day and generating a huge amount of greenhouse gasses. In this regard, those nations are now turning toward renewable and alternate energy resources in order to safeguard sustainability of energy sector and make the environment free of greenhouse gasses. The developing countries, whose demand is not yet meet, have made commitment to generate a specific percent of power from renewable energy. However, the progress of different countries varies depending on different factor like availability of energy resources, technical knowledge and skilled people etc. Here progress in opting for renewable and sustainable energy resources of few nations has been discussed in detail.

### A. China Progress

Power generation growth in China accelerated after 1990 surpass USA. Owing to existence of coal in abundant, the main resource of China power generation is coal that produced about 5920 TW by 2016 which is around 66% of the total generation. However, china stop further generation from coal and opt for renewable energy resource i.e. wind and solar energy resources.

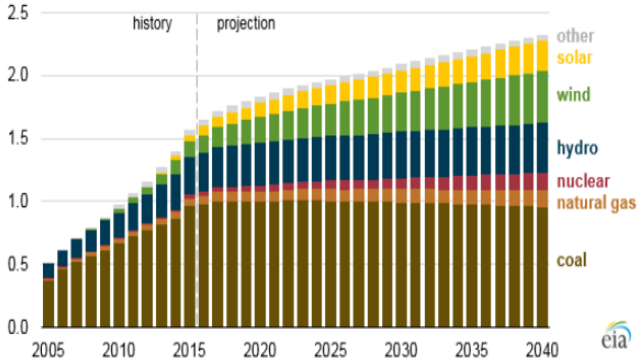



Fig.6. Share of resources in Energy Mix from 2005 to 2040 in China.

China having large costal area has 2380 GW of wind energy potential on land while 200 GW of wind capacity is on the sea. In 2016 china has add 19.3 GW of wind power which make the installed capacity of wind energy resource around 149 GW. According to China forecasting, the power generation from wind energy will be 250 GW by 2020 as China government has pledged to generate 15 percent of the total energy from renewable energy resource. A road map has been designed by Chines government up to 2050 for utilization of wind energy for power generation. According to that road map, China has aimed to produce 400 GW of electricity by 2030 that will satisfy the 8.4% of the energy need of China and 1000 GW of power will be generated using wind energy resource by 2050. The total investment on wind energy project from 2010 to 2050 is shown here in graph, wherein investment raised very sharply after 2038. Since the power generation in China is dominated by coal, which results in huge amount of carbon emission, but once the targets have been achieved wind energy will eliminate 130 million tons of coal equivalent (mtce) by 2020 and 260 mtce by 2030.

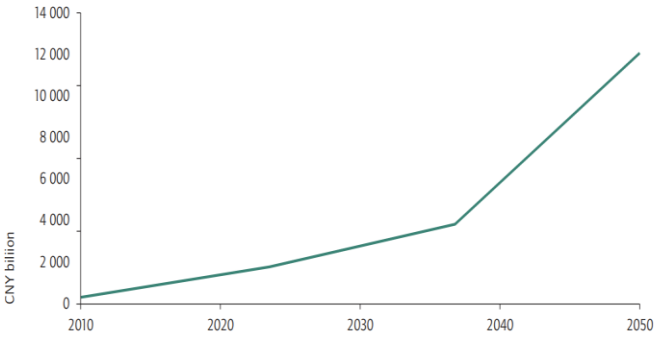



Fig.8. Investment in Wind Energy of China.

China is not only the major market for solar thermal energy and photovoltaics but also become the world's top installer and also power generation country in 2015 from photovoltaic after Germany and later in coming years China has further increased its power generation from total PV capacity. 77.4 GW PV energy capacity was reported by the end of 2016 in China, which was later enhanced to 130 GW in 2017. A major breakthrough is seen in 2018 after successful project of 1547 MW at Tengger. The aim of harnessing 1300 GW of power from solar energy by 2050 is set which would be the largest power producing source if the target is achieved in time.

### *B. United State progress*

United states also import electricity from Canada to fulfill their own electricity demands and other countries, they give their electricity to the Mexico. In the year 2012 the amount of total electricity import by the US is 47000 GWh which is nearly 1.2 % of the total electricity production by the US from their own resources.

The Nuclear program of the United States are mainly depended on the uranium imported from other countries. The production of the Uranium with in their own country is only 8 % of the total uranium used in the nuclear program of United States it means that the remaining amount of uranium is imported from other countries. They import their uranium from Australia, Namibia, and Russia and from the Canada.

There are five major Sectors in the United States which are the main consumer of energy in the US and these five sectors are declared by the US Energy Administration (EIA). Most of the energy is use in the generation of electric power and its percentage is 38.1 %, after that a huge energy is consume in the Transportation sector and its share is 28.8 percent, Industrial sector of the US has also a huge effect on the energy consumption and they consume nearly 22.4 percent of the total energy. The energy consumption by the Residential and commercial sector is low as compare to others and their share is 6.2 and 4.5 percent respectively.

The share of the Renewable energy in the production of electricity in US by the year 2013 was equal to 12.9 %. In year 2011 the energy comes from the renewable energy resources has achieve a very huge target and contribute 11.7 % of the total energy generate in the united states, and the amount of energy is 2.245 quadrillion of energy in BTUs. This huge amount of energy produced from renewable resources is much greater from the energy produced from the nuclear power in year 2011 which is 2.125 quadrillion of energy in BTUs. This is first time in the history of US that the production of energy from the renewable resources cross the production of energy from nuclear resource since year 1997.

The major portion in the energy comes from the renewable resources in the United States is the energy from hydropower. The electricity or energy produced from the hydropower is 6.2 percent of the overall energy produced in the United States in year 2010 and this 6.2 percent of the total energy is nearly about 60.2 percent of the total energy produced from the renewable energy resources in the US. In the race of electricity production from the hydropower the US is on the 4$^{th}$ position, and China, Canada and Brazil are on the 1$^{st}$ 2$^{nd}$ and 3$^{rd}$ positions respectively. US has one of the largest dam in the world named as The Grand Coulee, at has 5$^{th}$ position in the race of large dams.

There is also a huge potential of wind power in the United States and the Capacity of the installed wind power is greater than 65,000 MW. The power produced from this single resource in the year 2014 in the US was 181.79 terawatt's and this power is equal to the 4.44 percent of the over electric power produced in the year 2014. Most of the Wind turbines are installed in the Texas following by the lowa and California.

There is also a lot of works is done on the solar thermal potential in the US and large power plants which base on solar thermal has been made. Among these solar thermal power plants the largest on is made in the Mojave Desert and have the ability to produce 354 MW of energy, and this power plant is one of the largest power plant in the world.

The united states have also a large capacity of Geothermal energy and they have capacity of geothermal is near about 2,957 Mega watt.

## V. PAKISTAN STRATEGIC PLAN FOR ALTERNATE AND RENEWABLE ENERGY

Owing to the dependence of major percentage of Pakistan power generation on oil and its import, price variation of oil in the international market inflict profound influence on power generation in Pakistan. To overcome this problem Pakistan needs to introduce its own resources that are sustainable in the energy sector. Pakistan has vast potential of renewable energy resources i.e. solar, wind, geothermal, biomass energy and hydel energy, which not only fulfil the energy demand of the country but also ecofriendly system. In this context, Pakistan has established a number of organization that were specialized to ensure the optimum percentage of alternate energy share in the energy mix of Pakistan. Pakistan Council of Renewable Energy Technology (PCRET) was founded my merging of two other organization to carry out the Research and Development work in the field or renewable energy. Alternate Energy Development Board (AEDB), established in 2003, is specialized to introduce renewable energy in the total energy mix of Pakistan and look after the alternate energy policies, encourage and facilitate development in the alternate and renewable energy in order to improve the economic growth of Pakistan. In 2006 Pakistan device a policy "Alternative and Renewable Energy Policy, 2006" to introduce clean, indigenous and rich alternate and renewable energy resources that must be used meaningfully and timely fashion to get maximum advantage of resources wherein Pakistan is blessed to overcome the social and economic woes of the country. Later in 2011, another policy was formulated in the continuation of previous policy to sustain the progress in promotion of renewable energy. Later power policies have the incentive for private sector to promote renewable energy in Pakistan.

### A. *2016 Policy of Pakistan Traits:*

AEDB launched 2006 "Alternate and Renewable Energy Policy" for the first time to introduce renewable energy formally in energy mix of Pakistan. This policy is devised simply to encourage and support those power projects, which are based on renewable energy resources. The objective set in this policy was to make the renewable energy resource to generate 10% of the total energy mix of Pakistan by 2015.

This polices was focused on wind, micro hydro project and solar energy. The major features of this policy is discussed here:

- Expedite the deployment of alternate and renewable energy technologies that will increase the share of renewable energy in the energy mix and helpful to meet the energy demand.
- Facilitate the private investment in ARET by giving them incentive and implementing market oriented strategy to encourage the private investor.
- Take solid actions to mobilize investment plan and technically assist local manufacturing facility for renewable energy technology in order to make the new technology cost effective and increase the job opportunity for local and enhance domestic level technical expertise.
- Enhance social welfare activity in undeveloped and distant area where people live in poverty and depend on unhygienic cooking fuel, which can be proven as life changing activity for local people.

The incentive to meet these objectives given in the policy was quiet attractive some of which are

- Encourage the private investor to submit their proposal in following categories
  1) Selling generated power to the gird entirely (IPPs)
  2) Generate power for own use and sale to utility
  3) Small standalone power projects
- Formalities like implementation Agreement (IA), Letter of Intent (LOI) and Letter of Support are not needed for the projects all other than non-IPPs.
- Net metering and billing for those producers having excess production of power are allowed at a given point in time.
- By the payment of wheeling (transmission) charges, producer can generate and add electricity at any point of the national grid and can get the same amount of electricity at other point of national grid.
- Equipment for renewable energy generation are exempted form income tax, custom charges and income taxes etc.
- Utility companies that are responsible for purchasing power will bear the risk and give security against unpredictable renewable resources i.e. irregular and unpredictable flow or wind speed.
- Electricity supply companies are responsible for purchasing the all power generated by using renewable energy.

## VI. OBSTACLES IN SHIFTING THE POWER GENERATION TO ALTERNATE AND RENEWABLE ENERGY.

Nevertheless, harnessing power from potential renewable energy resources has long been conceived and good intention to opt for green and sustainable energy has been announced now and then by private and public sectors but solid progress has not yet been achieved owing to different factors. In order to ensure the significant growth in green and sustainable energy these obstacle and problems should be address well in time to get optimum advantage. The remedy of all the problems discussed below and its execution should be considered and ensure in the policy purposefully.

### A. *Power setup based on conventional electricity generators:*

Renewable energy in the race with conventional energy is lagging behind because the existing setup of the conventional energy mainly based on fossil fuel does not provide a smoot path to flourish in the market. However, in recent years, the new technology adopted for power generation was renewable energy technology but most of the country opting for alternate energy was those countries having no energy shortfall problem. In country like Pakistan, where the economy is not enough to overcome the problem of shortfall has to opt for the cheap and easily available technology. Because of the unavailability of local industry for manufacturing renewable technology at economical rate has kept the conventional energy technology at top. Some of low quality small hydropower plant turbine i.e. crossover turbine factories are present that manufacture turbines for small hydropower project in Northern area of Pakistan. In contrast, conventional energy technology is well-established and running to meet the demand of power. Government has significantly subsidized the crude oil it is also a great impetus for private sector to invest in conventional power generation and the government buys generated power at exorbitant rates.

### B. *Insufficient knowledge of technology*

Even if a number of organization have been specialized to work on dissemination of knowledge regarding to renewable and sustainable energy, authentic data of potential of different renewable energy resources and the feasibility of harnessing that energy is not yet compiled. Lack of technical knowledge remained a major barrier in the introduction of renewable energy project on big scale. Technical data related to the flow of water and wind remained a potential threat to proper running and getting smooth power from these plants that can lead to the waste of money and irregularity in electricity supply to the connected locality.

The projects which are already been using for generation need regular maintenance to enhance its lifetime and get

maximum return in order to make the renewable energy generation more feasible. However, little information and knowledge project negative image of it which in return have negative impact on the policy making this regard. Systematic feedback information can enhance the practical exposure. Lastly, owing to import the technology, the manufacturer most of time share partial information and keep some information to earn maintenance charges which need to build own industries or at least train technician to cope with any technical fault.

### *C. Weak Infrastructure barrier*

One of reason that proved eminent hurdle in the introduction of renewable energy in energy mix of Pakistan is poor infrastructure of transmission line. Major potential area of renewable energy resource are far distance from the national grid, which make it uneconomical to connect. Because of this reason, mostly the renewable energy systems are decentralized and feed the local community. The existing power system infrastructure of Pakistan cannot sustain for long period, it will need restructuring and that will provide a chance to integrate renewable energy system with existing system.

### *D. Policy Limitation:*

Policy 2016 is specially devised to integrate alternate and sustainable energy system in the energy mix, which is revised in 2010 to bring further improvement but not any significant development has been made. The low pace of development is because of lenient policies for renewable and alternate energy technology. As Pakistan has more dependence on conventional energy resources to meet its energy demand therefore the subsidies on fuel and facilities on conventional energy are more attractive therefore, the new project adopted for power generation is mostly based on non-renewable and low-priced resources and compromise the objective of sustainability and ecological aims power generation.

### *E. Lake of research and development work in Renewable Energy Technology:*

Sustainability of power sector in Pakistan and other part of the world has vital dependence on renewable energy resources that can insure all the aspect of sustainability. To flourish renewable energy in country like Pakistan where the potential is in abundant need to work on the technology and develop novel ideas to enhance this sector. Lack of research and development works have abstain this sector to grow. Because of the existing setup of conventional power plant needs a handsome amount of budget that remain hurdle to invest in research and development of renewable technology which need laboratory of expensive equipment. There are several department i.e. Pakistan Council of Renewable Energy Technology (PCRET), USPCASE Center at NUST and UET Peshawar but it is not sufficient to meet the need of technology advancement.

### *F. Institutional impediments:*

Before 2001, there was not a single department present to look after the renewable technology. Pakistan Council of Renewable Energy Technology (PCRET) was founded my merging of two other organization to carry out the Research and Development work in the field or renewable energy. Alternate Energy Development Board (AEDB), established in 2003, is specialized to introduce renewable energy in the total energy mix of Pakistan and look after the alternate energy policies, encourage and facilitate development in the alternate and renewable energy in order to improve the economic growth of Pakistan. AEDB launched 2006 "Alternate and Renewable Energy Policy" for the first time to introduce renewable energy formally in energy mix of Pakistan. However, the departments responsible for generating conventional energy in the existing structure have no serious interest in integration of non-conventional and renewable energy. National Transmission and Distribution Company (NTDC), which deal with national grid, has shown unresponsive in last few years to provide transmission line to the renewable energy project. Now NTDC has planned to develop new transmission structure to incorporate the new green and sustainable power generation project.

## VII. SUGGESTION

Suggestion to improve the sustainability of energy sector in Pakistan is discussed here.

- The target for the renewable energy in the energy mix of Pakistan should be revised and set high target of about 15% of total energy generation. To attain set target proper indicator and policy should be clearly define. Government should formulate a mechanism to ensure compliance with the devised police and laws.
- Proper feasibility study of renewable energy resources in different area of Pakistan should be conducted to make the path uncomplicated for allocation of budget and secure to invest in.
- Dedication and sincere intention of policy maker and executer to promoting renewable and alternate energy technology is needed, whereas monopoly system should be discourage.
- Policy to encourage renewable energy technology is not enough to prosper in existing setup where the conventional energy is being promoted by government with large incentives. Along with incentivize the renewable energy technology the conventional energy system should be discourage to possible extant.
- Massive government investment is needed to enhance the technical skill and education for renewable and non-conventional energy technology. Research and development center should be establish to ensure the sustainability of these new technology and make it more economical. Import of technology and technical skill increase the cost of these technologies, which can be

reduce by introducing own technology and maintenance setup.

- The technology imported should be manufacture according to ISO/IEC international standard to enhance the efficiency and safety, which also bring the sustainability factor in energy sector.

## CONCLUSION

This article delivers the thorough review of efforts made for sustainable energy in Pakistan and discussed the strategy and policy needed to ensure progress in the coming years. Previously, study related to develop and introduction renewable energy as new technology for power generation has been conducted. In this article, the struggle made and Policies devised by different countries for the achievement of goal set by United Nation "sustainable energy for all" have been compared.

The role of Pakistan in accomplishing the targets of UN sustainable energy goal is partially on track. Pakistan policy for renewable energy is will be productive if positivity executed. It is experienced that, albeit announcement of renewable energy policy, there is no noticeable progress in field of renewable energy sector. It needs meticulous study of policies especially in comparison with policy promoting the conventional energy, and devise a new policy which manage the controlled installation of new power plants taking care its of sustainability. Research and development work should be established to ensure technical solution to the problems. Awareness should be created among the masses about the conservation of energy. These efforts can ensure the sustainability of energy sector in Pakistan.

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