Paper No. 268

BARRIERS IN RENEWABLE ENERGY DEPLOYMENT IN PAKISTAN

By

Syed Tahawar Hussain

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Overview (Brief history, current installed capacity, potential)

Pakistan is blessed with abundantly available and inexhaustible Renewable Energy (RE) resources, which if tapped effectively can play a considerable role in ensuring Energy Security and Energy Independence of the country. Sporadic efforts and initiatives have been undertaken by the Government in the past leading to lackluster results due to non-commitment, improper and disjointed planning and lack of focused, integrated efforts on part of the stakeholders involved.

Realizing the need to integrate the efforts for promotion and development of Alternative Renewable Energy (ARE), the Government of Pakistan established the Alternative Energy Development Board (AEDB) as an autonomous and the apex national organization in April 2005 with the mandate to undertake development of medium and long term national plans and policies, promotional and dissemination activities in the field of Renewable Energy Technologies; and to facilitate power generation through alternative or renewable energy resources by acting as a one window facility for establishing, promoting and facilitating alternative or renewable energy projects based on wind, solar, micro-hydel, fuel cells, tidal, ocean, bio gas, bio mass etc.

AEDB has been assigned the following targets by the Government of Pakistan:

- Development of wind and solar energy to ensure that at least 5% of total power generation capacity is met through these resources by 2030 (i.e. 9700 MW).
- Alternative Energy Development Board to ensure the installation of 700 MW of wind energy at Keti Bandar and Gharo, Sindh through the private sector.
- Solar products like solar lights, solar fans, solar cooker, solar geyser, etc. must be developed through private sector on top priority.
- Laws and taxes designed to encourage self energy generation by domestic sector like use of solar heating, solar geyser etc.
- Provision of electricity to remote, off-grid villages through Renewable Energy Sources, e.g. solar, wind, biomass etc. 7,874 such villages in Balochistan and Sindh have been identified initially.
- Replacement of 5% of total annual diesel consumption with Biodiesel by the year 2015, and 10% by the year 2025.

Current installed capacity of ARE in the country (excluding large hydro projects above 50 MW capacity) is roughly around 25 MW only.

Potential for various ARE technologies in the country vary from significant to phenomenal, which is as follows:

- Wind: 346,000 MW
- Solar: 2.9 Million MW
- Small Hydel: 2,000 MW
- Bagasse Cogeneration: 1,800 MW
- Waste to Power: 500 MW

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In addition, potential for other ARE technologies such as Geothermal, Wave Energy, Tidal Energy, Biomass etc. also exists but is yet to be determined. In this regard the following activities have been completed:

- National Renewable Energy Laboratories (USA) under the USAID assistance program in 2007 has carried out the wind resource study of Pakistan and developed a meso scale map showing the wind speed potential available at 50m altitude. NREL study has also indicated the wind corridor in the south of Pakistan as already been discovered by PMD. The NREL wind resource map of Pakistan has given a great boost to the wind power development activities in the wind corridor regions. Now this potential area has become the focal point for the development of wind energy in the near future.

- Wind mapping of Gharo-Kaiti Bandar wind corridor has been conducted. Solar Map of Pakistan has also been completed by NERL/USAID.

- A Feasibility Study conducted by SNV of Netherlands indicates the potential of 5 Million Biogas units for domestic use; one of the largest in the region.

- Estimated potential for electricity generation through Biomass / Waste to Power (including Bagasse cogeneration) also exceeds 2000 MW.

Table 1: Renewable Energy Generation in Pakistan

Sr. No.	Technology	Province	Village Name	District	Number of Houses	Year of Commissioning	Generation (MWh/ Year)	Capacity (kW)
1	Solar Energy	Punjab	Narian	Rawalpindi	53	2005/2006	80.59	27.60
			Khorian	Rawalpindi	57			
			Basti Bugha	D.G Khan	100			
			Lakhi Bair	D.G Khan	135			
		Sindh	Pinpario	Chachro	100	2005/2006	50.22	17.20
			Bharomal	Chachro	115			
		N.W.F.P	Shnow Garri	Kohat	100	2005/2006	51.39	17.60
			Janak	Kohat	120			
		Balochistan	Takht	Kalat	100	2005/2006	51.63	17.68
			Killa Mama Macherzai	Killa Saifullah				
			Allah Baksh Bazar Dandar	Turbat	121			

Sr. No.	Technology	Province	Village Name	District	Number of Houses	Year of Commissioning	Generation (MWh/ year)	Capacity (kW)
2	Micro Wind Turbines	Sindh	Goth Gul Muhammad Khaskheli	Mirpur Sakro	12	2006	91.10	52
			Goth Jumo Khan Khaskheli	Mirpur Sakro	60			
			Goth Ismail Khaskheli 1	Mirpur Sakro	5			
			Goth Ismail Mahpar	Mirpur Sakro	8			
			Goth Mohd Hasan Khaskheli	Mirpur Sakro	14			

			Goth Allah Dino Mahpar	Mirpur Sakro	14			
			Hot Khan	Gharo	10			
			Goth Sher Muhammad Hamaiti	Gujjo	48			
			Goth Daandaari	Ghorabari	250			
			Goth Lukman	Ghorabari	20			
			Goth Sammo	Ghorabari	19			
			Goth Ali Hasan Paareri	Ghorabari	120			
		Balochistan	Goth Meer Isa	Lasbela	3	2006	13.14	7.50
			Goth Ramzan	Lasbela	15			
			Goth Haji Sher Muhammad	Lasbela	35			
			Goth Yaaqoob	Lasbela	18			
			Goth Mir Abdullah	Lasbela	8			
				Lasbela	32			
	Micro Wind Turbine Installed by K.H.FARMA Ltd	Sindh (Karachi)					262.80	150
3	Rural Electrification Programme	Sindh		Tharparker	3,000	2008/09	244.46	167.44
4	Micro/Mini Hydel	Punjab	-		-		-	80
5	Biomass (Bagasse to Energy)	N.W.F.P	-	D.I.Khan	-	2008	94,608	27,000
6	Biomass (Anaerobic Digestion)	Punjab	-	Multan	-	2007	56,064	8,000
	Total						**151,517.33**	**35,537.02**

Source: AEDB / Pakistan Energy Year Book 2008

1. Global Renewable Energy Status

Table 2: Global Renewable Energy Status

Selected Indicators	2005	2006	2007
Investment in new renewable capacity (annual)	$40 billion	$55 billion	$71 billion
Renewables power capacity (existing, excl. large hydro)	182	207	240 GW
Renewables power capacity (existing, incl. large hydro)	930	970	1,010 GW
Wind power capacity (existing)	59	74	95 GW
Grid-connected solar PV capacity (existing)	3.5	5.1	7.8 GW
Solar PV production (annual)	1.8	2.5	3.8 GW
Solar hot water capacity (existing)	88	105	128 GWth
Ethanol production (annual)	33	39	46 billion liters
Biodiesel production (annual)	3.9	6	8 billion liters

Source: Renewables 2007 Global Status Report, REN 21

1.1 Global Market Trends

- Renewable power capacity of about 240 GW in 2007 (ex. large hydro) represents almost 6% of total global power capacity (~4,300 GW) and the share is increasing.
- Over 70 countries now have wind power, and many developing countries have joined the trend recently, including Brazil, Egypt, Iran, Mexico, Morocco, and South Africa, all with added capacity in 2006.
- Offshore wind power grew significantly in 2006-2007, with several projects in the 100-300 MW range underway in Europe and the United States.
- Solar PV market growth is centered in Germany, Japan, Spain, Italy, South Korea, California, and New Jersey, but with the market now broadening to more countries and states (such as France).
- Rooftop solar collectors provide hot water to over 50 million households worldwide, most in China. China now represents 75% of global annual additions of solar hot water.
- Geothermal heat pumps are a rapidly growing market, with over 2 million heat pumps used in over 30 countries, mostly in Europe and the U.S.
- Biomass-fueled heating still provides five times as much heat worldwide than solar and geothermal combined, and continues to grow in northern Europe.
- The U.S. has become the dominant ethanol producer (corn-based), although Brazil has started an ambitious program to increase production by 50% by 2009 (sugar-based).
- Ethanol provided > 40 percent of all (non-diesel) motor vehicle fuel in Brazil in 2005.
- Biodiesel production has increased at 20-100% annual rates in recent years, particularly in Germany, France, Italy, Poland, and the United States.
- Almost half of world biodiesel production continued to be in Germany.
- The first group of commercial-scale solar thermal power plants since the 1980s started operation in 2006-2007, including in Nevada (USA) and Spain. Many more plants are now planned.

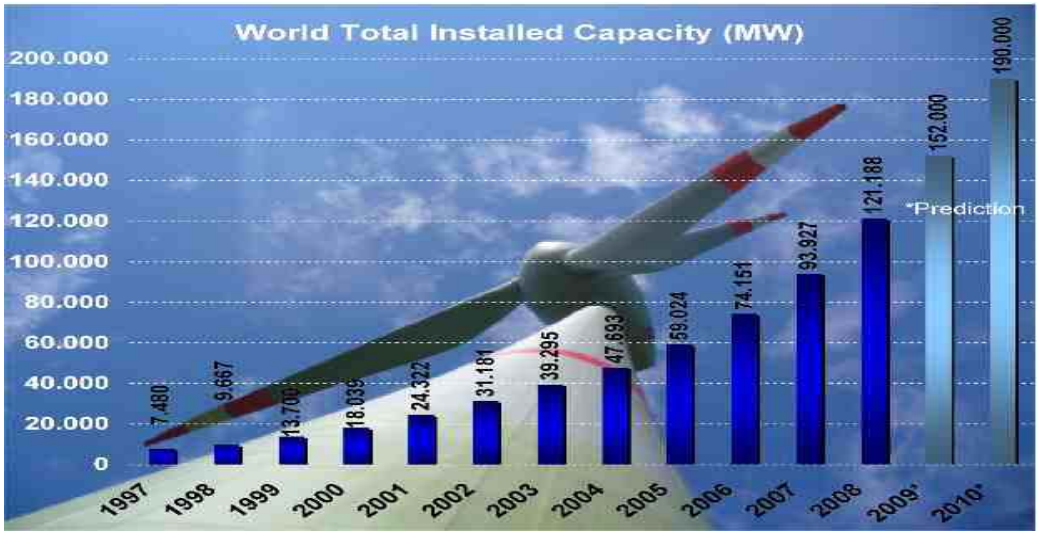

Table 3: Global Wind Installed Capacity, 2008

Position 2008	Country	Total Capacity installed end 2008	Added Capacity 2008	Growth Rate 2008
		(MW)	(MW)	(%)
1	USA	**25,170**	8,351.2	49.7

2	Germany	**23,902.8**	1,655.4	7.4
3	Spain	**16,740.3**	1,595.2	10.5
4	China	**12,210**	6,298	106.5
5	India	**9,587**	1,737	22.1
6	Italy	**3,736**	1,009.9	37
7	France	**3,404**	949	38.7
8	United Kingdom	**3,287.9**	898.9	37.6
9	Denmark	**3,160**	35	1.1
10	Portugal	**2,862**	732	34.4
11	Canada	**2,369**	523	28.3
12	Netherlands	**2,225**	478	27.4
13	Japan	**1,880**	352	23
14	Australia	**1,494**	676.7	82.8
15	Ireland	**1,244.7**	439.7	54.6
16	Sweden	**1,066.9**	235.9	28.4
17	Austria	**994.9**	13.4	1.4
18	Greece	**989.7**	116.5	13.3
19	Poland	**472**	196	71
20	Norway	**428**	95.1	28.5
21	Eygpt	**390**	80	25.8
22	Belgium	**383.6**	96.7	33.7
23	Chinese Taipeh	**358.2**	78.3	28
24	Brazil	**338.5**	91.5	37
25	Turkey	**333.4**	126.6	61.2
26	New Zealand	**325.3**	3.5	1.1
27	Korea (South)	**278**	85.9	44.7
28	Bulgaria	**157.5**	100.6	176.7
29	Czech Republic	**150**	34	29.3
30	Finland	**140**	30	27.3
31	Hungary	**127**	62	95.4
32	Morrocco	**125.2**	0.0	0.0
33	Ukraine	**90**	1	1.1
34	Mexico	**85**	0	0
35	Iran	**82**	15.5	23.3
36	Estonia	**78.3**	19.7	33.6
37	Costa Rica	**74**	0	0
38	Lithuania	**54.4**	2.1	4
39	Luxembourg	**35.3**	0	0
40	Latvia	**30**	2.6	9.5
41	Argentina	**29.8**	0	0
42	Philippines	**25.2**	0	0
43	South Africa	**21.8**	5.2	31.4
44	Jamaica	**20.7**	0	0
45	Guadeloupe	**20.5**	0	0
46	Uruguay	**20.5**	19.9	3,308.3
47	Chile	**20.1**	0	0
48	Tunisia	**20**	0	0
49	Colombia	**19.5**	0	0
50	Croatia	**18.2**	1	5.8
51	Russia	**16.5**	0	0

52	Switzerland	**13.8**	2.2	19.2
53	Guyana	**13.5**	0	0
54	Curacao	**12**	0	0
55	Romania	**7.8**	0	0
56	Israel	**6**	0	0
57	**Pakistan**	**6**	**6**	**New**
58	Slovakia	**5.1**	0.1	2.8
59	Faroe Islands	**4.1**	0	0
60	Ecuador	**4**	0.9	30.7
61	Cuba	**7.2**	5.1	242.9
62	Cape Verde	**2.8**	0	0
63	Mongolia	**2.4**	2.4	New
64	Nigeria	**2.2**	0	0
65	Jordan	**2**	0	0
66	Indonesia	**1.2**	0.2	20
67	Martinique	**1.1**	0	0
68	Belarus	**1.1**	0	0
69	Eritrea	**0.8**	0	0
70	Peru	**0.7**	0	0
71	Kazakhstan	**0.5**	0	0
72	Namibia	**0.5**	0	0
73	Netherlands Antilles	**0.3**	0	0
74	Syria	**0.3**	0	0
75	North Korea	**0.2**	0.2	2010
76	Bolivia	**0.01**	0	0
	Total	**121,187.9**	27,261.1	

Source: World Wind Energy Report 2008, WWEA

2. Policy Highlights (A brief description of successive policies relevant to the industry)

The ARE sector had been largely ignored prior to the establishment of AEDB. Upon its inception, one of the tasks undertaken by AEDB was the formulation of country's first ever Renewable Energy Policy. As a result, the Policy for Development of Renewable Energy for Power Generation was approved by the Federal Government and issued in December 2006. Salient features of the Renewable Energy Policy 2006 are as follows:

- It invites investment from the private sector for following categories of proposals:
  a. Independent power projects, or IPPs (for sale of power to the grid only)
  b. Captive cum grid spillover power projects. (i.e., for self-use and sale to utility)
  c. Captive power projects (i.e., for self or dedicated use)
  d. Isolated grid power projects (i.e., small, stand-alone)
- Except for Category (a) above, these projects will not require any LOI, LOS, or IA from the Government.
- Electricity purchase by NTDC / CPPA from qualifying renewable energy-based generation projects has been made mandatory.
- It permits an investor to generate electricity based on renewable resources at one location and receive an equivalent amount for own use elsewhere on the grid at the investor's own cost of generation plus transmission charges (wheeling).
- It allows net metering and billing so that a producer can sell surplus electricity at one time and receive electricity from the grid at another time and settle accounts on net

basis. This will directly benefit the economics of small scale, dispersed generation and optimize capacity utilization of installed systems.

- It de-licences and deregulates small scale power production through renewable resources (up to 5 MW for hydro and 1 MW for net metered sales) to reduce the transaction costs for such investments. This will be particularly beneficial for micro, mini and small hydro as well as solar-based electricity production.
- It lays down simplified and transparent principles of tariff determination.
- It insulates the investor from resource variability risk, which is allocated to the power purchaser.
- It facilitates projects to obtain carbon credits for avoided greenhouse gas emissions, helping improve financial returns and reducing per unit costs for the purchaser.

3. Demand/ Supply Scenario (Current vs Projected, graphs and tables can be included)

Current installed capacity of the country stands at 19,522 MW. There exists a shortfall of 6,000 MW today. The energy demand over the next five years is expected to grow at a rate of 7.4 percent per annum. In order to meet additional power generation requirement of 143,310 MW during 2005-2030, an investment of $ 150 billion would be required.

Renewable Energy, however, can effectively complement the conventional energy resources for meeting the demand / supply gap. Given the right kind of support, over 10,000 MW can be added to the national installed capacity through Renewable Energy resources by the year 2030.

4. Projects in pipeline at this time (Magnitude of projects and required investment, brief description, expected period of commissioning)

Several projects in different RE technologies, which include wind power projects, micro / mini hydel, bio mass / bio gas, waste-to-energy and solar, are currently in the pipeline. A detail of these projects is presented in Table-1 below:

Table 4: Renewable Energy Projects in Pipeline, Pakistan

Renewable Energy Projects In Pipeline						
	Name of Project	**Technology**	**Capacity (MW)**	**Expected Commissioning Year**	**Estimated Cost (Million $)**	**Implementation by**
	Zorlu Enerji Pakistan Ltd.	Wind	50	2009	121	Private sector
	Green Power Pvt. Ltd.	Wind	50	2010	135	Private sector
	Arabian Sea Pvt. Ltd.	Wind	50	2011	161.3	Private sector
	Dawood Power Ltd.	Wind	50	2011	133	Private sector
	Beacon Energy Ltd.	Wind	50	2011	135	Private sector
	Clean Energy Development	Bio Mass	25	2010	-	Private sector

Wind Power Projects

The wind power projects mentioned in the Table-1 are being developed in the Gharo and Jhimpir areas of Thatta District. Construction work is already in progress on one of these projects being pursued by M/s Zorlu Enerji Pakistan Ltd. and the first phase of the project of 06 MW will be completed by March 2009.

Solar Photovoltaic Projects

Under Rural Electrification Program (REP) AEDB is providing solar photovoltaic systems to households in 300 un-electrified villages of Baluchistan and 100 un-electrified villages of Sindh

with an envisaged expenditure of Rs. 1167.73 millions. More than 3000 households in Sindh have already been provided with the solar photovoltaic systems.

Bio Mass / Bio Gas Projects

M/s Clean Energy Development Ltd of New Zealand is actively working on the development of a 25 MW biomass project at Landhi, Karachi. The pilot phase of the project (250 kW) has been initiated and the full scale plant of 25 MW will be completed by 2010.

5. Challenges facing the sector (policy issues, technical challenges)

POLICY ISSUES

- The efforts of the government have not met with success mainly due to a lack of integrated planning and implementation mechanism. Unfocussed efforts with duplication of activities by various agencies which is uncoordinated combined with limited resources and constraints leads to confusion and attainment of targets is not possible. There is a proliferation of Government agencies often duplicating functions. These agencies under various Ministries are not empowered sufficiently to develop ARE resources, and are working with limited resources and constraints. Lack of coordination and cohesion among the agencies responsible for developing the ARE sector is preventing from achieving a critical mass concentration of these technologies. Scant, peripheral and parallel activities by various agencies also cause confusion among the Donor Agencies. The provincial governments do not have a proper 'buy-in' and do not support the process.

- Another key issue responsible for hindering the growth of ARE sector in the country is the general lack of capacity in the public sector, which coupled with the already burdensome approval process for RE IPPs, is slowing down tangible progress for setting up RE projects in the country. It is important to understand that building capacity is as important as adding Mega Watts to the grid. The challenge faced today is to make the different Government of Pakistan players coalesce around the development and implementation of a national RE strategy in a complimentary way.

- One of the most critical factors responsible for preventing the realization of RE projects, especially Wind Power Projects is that of **tariff.** More often than not, wind IPPs has found the tariff determined by NEPRA to be unworkable and unacceptable. The leading wind IPPs of the country, i.e., Zorlu Enerji, Green Power Pvt. Ltd. and Dawood Power Pvt. Ltd., all have gone through the cumbersome process of filing multiple tariff petitions with NEPRA due to the fact that the offered tariff was always considerably less than the one petitioned for. Green Power has so far gone through this process three times and still hasn't been awarded a tariff of its liking. This leads to inevitable delays in the project as the IPPs are unable to firm up their turbine supply and EPC agreements and the window of opportunity is lost; not to mention the direct and indirect additions to the project cost as filing of each tariff petition costs in excess of Rs. 2.5 Million and the turbine prices in the international market have been experiencing a continuous upward trend for the past three years. The biggest reason that not a single wind power project has come on-ground to date is that of tariff disputes with NEPRA; thus compounding the current prevailing energy crisis.

TECHNICAL CHALLENGES

- Renewable Energy projects are going to be a first in the history of country's power sector. Due to their unique nature and intermittent resource variability, they also pose technical challenges. The Government entities in the power sector are only experienced in dealing with thermal and large hydro projects, and are therefore not technically

equipped to handle RE projects. One of the main reasons for delays in developing a standard Energy Purchase Agreement for wind projects was lack of experience and capacity for understanding and handling the technical aspects of wind energy generation and dispatch issues.

- The currently enforced Grid Codes do not cater for Renewable Energy projects. Modification of these Grid Codes to successfully incorporate wind energy projects is proving to be a major technical issue and challenge. The issue needs to be addressed at the earliest possible to inject wind energy to the national grid without any further delays.

- The NPCC which is the agency responsible for managing and controlling the national grid, also lacks the experience to manage dispatch of wind energy to the grid.

6. 'Immediate Problems Immediate Solutions'

- Focused and integrated approach by the Government to develop the RE Sector is required without any further delays. This can be achieved by strengthening the AEDB as an institution, both in terms of its legal mandate and financial resources. Another practical and extremely useful approach can be to establish a separate ministry for Alternative Renewable Energy, along the similar lines as adopted by India and various other countries around the world which have served them really well. In this way, integrated efforts can be undertaken by the Government by displaying the necessary resolve and political will for development and promotion of RE.

- Renewable Energy around the world has flourished mainly due to the reason that it got unflinching support of the Governments in the form of binding targets, legislations and attractive incentives for private sector investment. Among them, the concept adopted universally with great success is that of Feed-in Tariffs and this mechanism should be adopted in Pakistan without any further delay. Feed-in Tariff not only takes into account the private cost of the project, but also accounts for the externalities arising due to social costs had it been a business-as-usual scenario using conventional energy resources. The approach adopted in Pakistan so far for such RE projects is on "cost-plus" basis. The cost-plus computation requires a case-by-case determination of the applicable tariff for every single producer. This approach is typically favoured by NEPRA in order to help reduce the risk faced by the developers who want to undertake such projects, since it guarantees a return-on-equity (ROE) of at least 15 %.

While this method reduces some of the risks to the developer, it also eliminates any additional incentive to develop these types of projects. For instance, the ROE assured is the same regardless the type of power generation project under consideration (i.e., renewable or conventional). This can lead to quite curious situations, such as that the upfront tariff allowed by NEPRA for conventional generation using reciprocating engines burning diesel oil is 25% higher than the upfront tariff for generation using wind, regardless of the benefits that the latter brings to the environment or in terms of fuel independence.

Additionally, available international evidence shows that feed-in tariffs are the best incentive mechanism for developing RE capacity, as can be observed in the cases of Europe and some BRIC (Brazil, Russia, India and China) countries.

- The few initial wind power projects may be exempted from the Grid Codes currently in vogue in the country so as to ensure their immediate despatch of energy. In addition, the Grid Codes should be revised to cater for off-take of wind energy based on the best international practices instead of re-inventing the wheel all over again.

- The Gharo – Keti Bandar Wind Corridor may be declared a perennial wind corridor by the Government, dedicated to the development of wind energy projects. This will help in making these projects bankable as it would be easier for financial institutions to finance these projects without any fear of land lease for the project being revoked by the Government of Sindh at any stage during the project life.

Mid term and Long Term Problems and Mid Term and Long Term Solutions

The issues addressed above are also generally applicable for the mid term as well as the long term. However the biggest challenge will be for the Government to continue its resolve to support the initiatives undertaken already and during the short term to make this sector a viable and sustainable option for Pakistan. This may include the following:

- Capacity and capability building of the public sector institutions involved with the development of RE sector, i.e., AEDB, NTDC, NEPRA, CPPA, NPCC etc.

- Development of an enabling environment for Renewable Energy technologies by introducing and implementing plans and policies that offer enough incentives to sustain the sector in the medium term and enable the RE technologies to become competitive with the conventional technologies on a level-playing field in the long term.

- Introduction and implementation of the feed-in tariff mechanism at least for the medium term.

- Introduction of binding targets and legislations for use of RE technologies, both for utilities and consumers.

- Incentives to manufacturers for indigenization of RE technologies, as it will help in not only considerably reduce the projects' cost in future but will also have a very positive impact on the overall economy of the country.

- Strengthening of the Alternative Energy Fund (AEF), which has been recently established with an objective to develop the RE sector and to promote PPPs as well as to assist the private sector for developing RE projects that have certain risk perceptions associated with them due to not having any past precedence in the country.

7. Investment requirement for the next 15 years to carry out major projects. How will the capital requirement be met?

On –grid RE projects in the country are mainly being established on the IPP model. However pilot projects are planned to be undertaken by the public sector to provide a certain level of comfort to the private sector for investing in such projects of mega scale. In addition, RE projects are also being undertaken by the Government to improve the livelihood of the impoverished inhabitants of remote, off-grid areas with a view of social development and meeting the Millennium Development Goals.

To meet the projected targets in the next 15 years, an investment of USD 500 Billion will be required for wind energy projects alone. USD 250 Million may be required for Rural Electrification Programme.

This capital requirement may be met from various sources, including Government funding, e.g. PSDP, international donor agencies (who are already supporting such initiatives in Pakistan, e.g. ADB, UNDP/GEF, USAID, EC, World Bank etc.), and the private sector which may be the biggest driver for investment in the RE sector. However it is estimated that a support of USD 1-2

Billion dollars during the mid term will enable the sector to become self-sustainable in the long term.

8. Opportunities for improving efficiency (production, transmission)

Renewable Energy technologies, by default, are the most energy efficient options available. Implementation of RE technologies will result in considerably improving the efficiency of the country's power sector.

In addition, one of the biggest advantages of utilizing RE technologies is the reduction of T&D losses in the grid. This is achieved either by having the electricity generating source right next to the point of consumption or relieving the grid of the amount of power that is otherwise generated by an RE application.

Hence using RE options provides excellent opportunities for considerably improving both the production and transmission efficiencies of the overall grid system.

9. Opportunities for technological enhancement

Promotion of RE technologies in the country can also open the floodgates to technological advancement of Pakistan in this area. Indigenization and transfer of such technologies can bring about a revolution in the engineering and industrial sector of the country. Another advantage that can be gained out of this technological advancement is the strategic location of the country. Pakistan has the potential of becoming a hub for exporting the RE technologies and equipment to the countries in the region.

10. Biodiesel

Oil imports of Pakistan continue to rise, presenting a serious cause of concern for the Government due to rising and unstable crude oil prices. Pakistan consumes 8 Million tons of Diesel annually out of which 4 Million tons is imported. Diesel is consumed by the industrial, transportation and agriculture sectors, which make up for 75% of the country's annual energy use at 26.280 MTOE. 10% of country's annual Diesel consumption replaced with Biodiesel will result in estimated savings in excess of US $ 1 Billion per annum.

The ECC of the Federal Cabinet approved the Policy Recommendations for Use of Biodiesel as an Alternative Fuel in February 2008, which has set the indicative target of Gradual introduction of Biodiesel fuel blends with petroleum diesel so as to achieve a minimum share of 5% by volume of the total Diesel consumption in the country by the year 2015 and 10% by 2025.

Pace of development of Biodiesel sector in Pakistan is such that events may overtake policy leading to Government losing control over the production of Biodiesel which can either destabilize this sector or stint its growth before the sector gets the opportunity to mature and become viable. Integrated and focused efforts are required on government's part as multiple stakeholders are involved from the public sector including AEDB, Ministry of Food, Agriculture & Livestock, Ministry of Petroleum & Natural Resources, PSO, OGRA as well as the provincial governments. These stakeholders need to realize the gravity of the situation and address all the critical issues associated with the sustainability of the National Biodiesel Programme spearheaded by AEDB. Immediate decisions are required in order to effectively address these issues and formulate a National Biofuels Policy in the soonest possible time span.

10.1 Issues & Recommendations

- Any act or policy formulated in haste without first catering to all the relevant issues and plugging the techno-economic gaps in this largely untested sector, will only lead to disastrous results. This is one area where the government needs to tread very carefully

as a false start can derail this fledgling sector, adverse effects of which will be felt on the economy for a very long time; a situation Pakistan cannot afford given the current energy crisis.

- Only non-edible oil feedstock may be allowed for Biodiesel production as a policy decision. However another important issue that can't be ignored is the quality of the Biodiesel thus produced and its conformance to international standards. Inferior quality Biodiesel produced from a certain feedstock will only serve to damage the National Biodiesel Programme. Hence it is imperative to carefully evaluate the pros and cons associated with a certain type of feedstock before it is given priority or preference over other available feedstock for production of Biodiesel.

- Aggressive R&D is being conducted globally to identify next-generation Biodiesel feedstock options to diversify Biodiesel production resources, otherwise known as lignocelluloses. The technology will allow Biodiesel to be produced from any plant material, there would be no conflict between the need for food and the need for fuel. It will also significantly lower the Biodiesel production cost. R&D efforts in this regard need strong and continuous support & commitment from the Government to ensure the viability and sustainability of the National Biodiesel Programme.

- As already mandated by the ECC, AEDB is to spearhead the National Biodiesel Programme and ensure that the targets determined by ECC are met with successfully. However there already is a duplication of efforts as evidenced by the Committees formed under the President ZTBL and Adviser to the PM on Finance for Biofuels, which also include Biodiesel in their TORs. The government needs to empower and strengthen the agency mandated with this responsibility accordingly so as to enable it to formulate and come up with the necessary Policy and Regulatory framework by involving all the stakeholders

11. Recommendations and Conclusions:

Today's global quest for energy is impacted by the following realities:

- Depleting Fossil Fuel Reserves
- Geo-political Issues
- Volatile Oil Prices
- Environment Concerns

Collectively, these issues have dictated a global shift in strategy which has led to a growing trend for utilization of clean Alternative Renewable Energy (ARE) technologies world-wide. In addition, issue of Social Responsibility in the form of binding agreements for CO_2 emission reductions has put an obligation on countries around the world for adoption of ARE technologies. This had forced both the developed and developing nations of the world to show resolve for promoting ARE technologies by setting firm mid and long term targets for replacement of conventional energy based generation systems to RE based generation systems. Pakistan is also obligated to show its resolve to the world in this regard by establishing itself as a responsible and serious nation committed to the cause of protecting the environment degradation. Hence it is imperative for Government of Pakistan to support and develop the ARE sector.

This can be achieved by adopting the following recommendations:

- Fixed 'Feed-In Tariffs' for a five year period be introduced that are competitive with the world and not based on a "cost-plus basis." This would give the RE sector a 'jump-start'

and enable investors to 'fast-track' the project. It would have a multiplier effect for job generation and boost the engineering industry in the country.

- Setting of firm targets for RE deployment over the short, mid and long terms taking into account that there are no recurring fuel costs and after the first ten years of a project life the tariff will drop significantly as the capital cost is paid off..
- Wind mapping to cover the whole of Pakistan to be comprehensively carried out.
- Enactment of legislations for mandatory use of RE technologies. For promotion of RE technologies, high profile targets in government buildings should be initiated to develop success stories.
- Provincial, city and local governments should be given monetary incentives to introduce RE technologies in various projects.
- Removal of policy and regulatory barriers.
- Formulation of favorable policy and regulatory framework for deployment of RE technologies including feed-in tariffs and obligating the utilities to meet a certain percentage of their electricity demand with RE technologies. Similarly, power distribution set-ups (DISCO's) should be 'incentivised' to utilize RE sources.
- Smart Grids be developed with reversible meters to allow utility companies to purchase surplus power generated by consumers.
- Institutional strengthening of AEDB. A review should be carried out to create an independent Ministry of Renewable Energy for focused efforts for growth of all RE activities.
- Financial support of the RE sector by strengthening the Alternative Energy Fund (AEF) and provision of an estimated USD 1-2 Billion till the year 2016, beyond which AEDB and the RE sector should be able to sustain itself.
- City governments should be encouraged to produce bio-energy through anaerobic digesters to produce power.

The investment potential for the RE sector of the country from short to medium term is over USD 16 Billion Dollars, which if supported through Government resolve and initiative can help in turning around the energy sector of the country; not to mention an overall strengthening of the country's economy and its projection around the world as a responsible, modern and committed nation. RE deployment has to be supported by the Government as a strategic option.