

WIND POWER GENERATION IN PAKISTAN: BLESSED CORRIDOR FORSAKEN?

An Assessment of Developmental Challenges and their Solutions

ALI AGHA

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ABSTRACT



- Pakistan is in the worst energy crises of history and in dire need to address this growth challenge going forward in the 21st Century. The so called 'Yawning Gap' between installed capacity and current generation can result in social turmoil and regional instability. In the backdrop of rising oil prices and depleting fossil reserves there is a need to adopt Renewable Energy Technologies (RETs) globally and in Pakistan.
- The essay develops the argument that if wind project success is to be developed than a logical approach would be to examine existing literature on developmental challenges around wind energy. Through extensive analysis of current and previous studies from 1986 to 2014 the essay discovers that most pertinent development challenges fall in three broad dimensions namely technological, government policy and financial.
- The paper synthesizes a collective topology of challenges to wind energy development from existing research on Pakistan but based on world class frameworks such as NREL (2007). The research then focuses on solutions to these developmental challenges by policy makers within Pakistan as well as countries that have had great successes in the wind energy. States at a similar stage of development to Pakistan such as most SAARC countries including Bangladesh are also examined, and one control case of the Caribbean to gain useful insights.
- The paper finally synthesizes this 'case based' learning in wind power challenges from Pakistan, leading countries and comparable states into a workable solution set for the Pakistan scenario ensuring greater likelihood of future project success.

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AGENDA



- *Background*
- *Introduction to Literature Review*
- *Development Challenges in Other Countries*
- *Conclusion*
- *References*

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BACKGROUND



This essay explores the potential of wind power generation in Pakistan by examining the challenges faced in project development historically and proposes solutions in the light of global best practices using country case studies from global leaders and peers.

- Wind is the fastest growing energy source in the world with the least environmental impact (Wiser, 2011).
- Global wind power generation capacity has doubled every three years and the cost of generation has fallen to one-sixth its previous price point (Akerman, 2000; Mirza, 2006)
- Wind power also has the potential to reduce Green House Gas (GHG) emissions in the near and long term (Wiser, 2011).
- Confronted with the reality of global warming from continued and irresponsible use of fossil fuels, current energy thinking is moving towards renewable clean energy sources (Asif, 2011).
- Nearly half of the estimated 194 Giga Watts (GW) of new capacity added globally in 2010 came from renewable energy (RE) sources (Panwar 2011; REN21, 2011).

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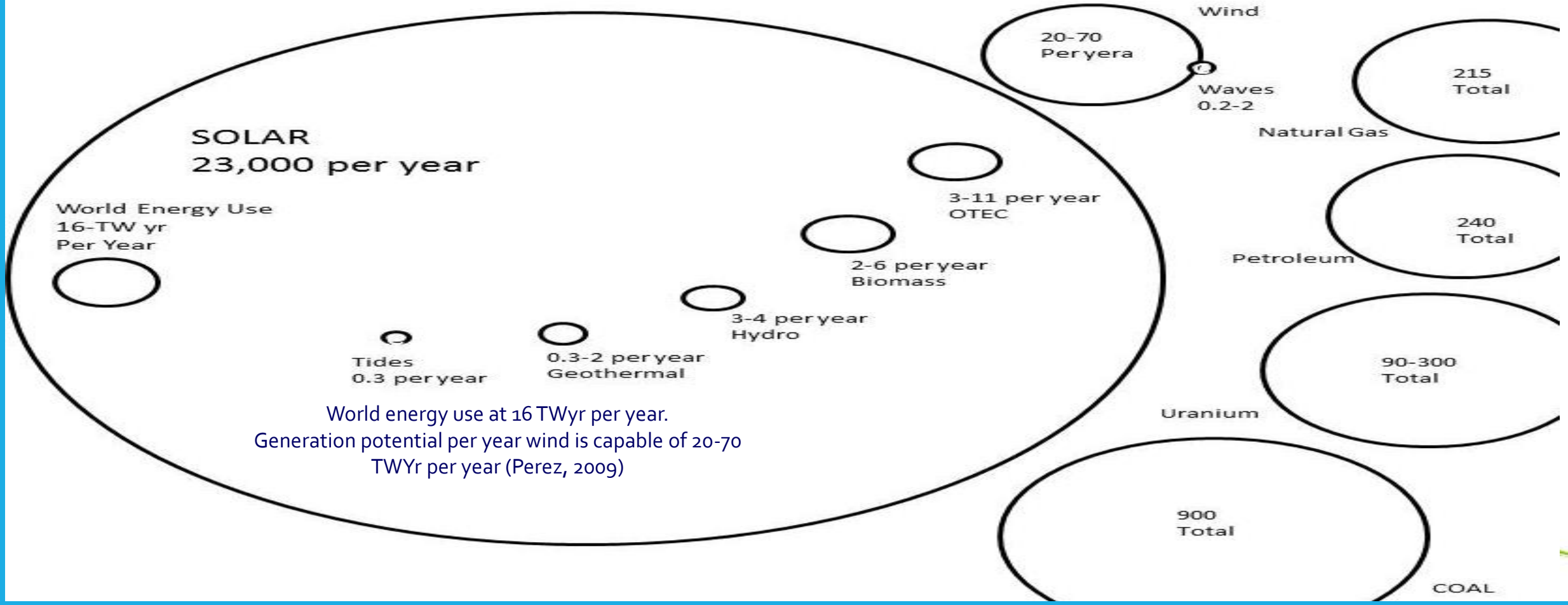
BACKGROUND (Contd.)



PLANETARY STUDIES

Wind is a resource capable of single handedly powering the planet. Powerful statistics like the ones above have placed wind power at the center of the global energy debate (Wiser, 2011).

A FUNDAMENTAL LOOK AT THE ENERGY RESERVES FOR THE PLANET



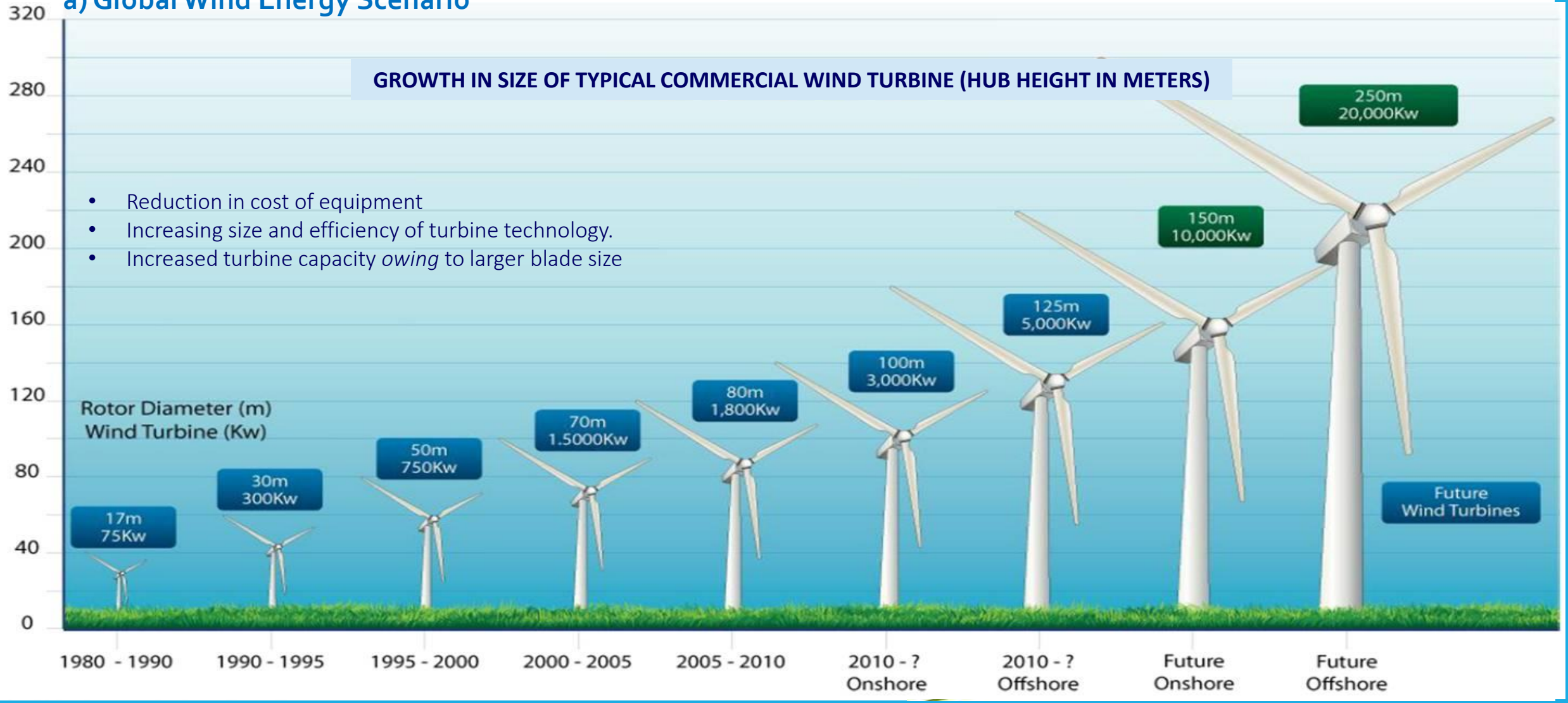
World energy use at 16 TWyr per year.
Generation potential per year wind is capable of 20-70 TWYr per year (Perez, 2009)

[Source: Perez, R. and Perez, M. 2009]

BACKGROUND (CONTD.)



a) Global Wind Energy Scenario



- Reduction in cost of equipment
- Increasing size and efficiency of turbine technology.
- Increased turbine capacity *owing* to larger blade size

Source: IPCC (2011), Special Report on Renewable Energy

BACKGROUND (CONTD.)



a) Global Wind Energy Scenario

The recent emergence of China and India as leaders in wind energy
'Wind Energy Rankings', represents a dramatic shift in an industry traditionally dominated by European players (see figure 3)
Advancement in Wind Turbine Design

TOP TEN CUMULATIVE CAPACITY WIND ENERGY 2011

- China
- USA
- Germany
- Spain
- India
- France
- Italy
- UK
- Canada
- Potugal
- Rest of world

Source: EEA. European Environment Agency (2012)

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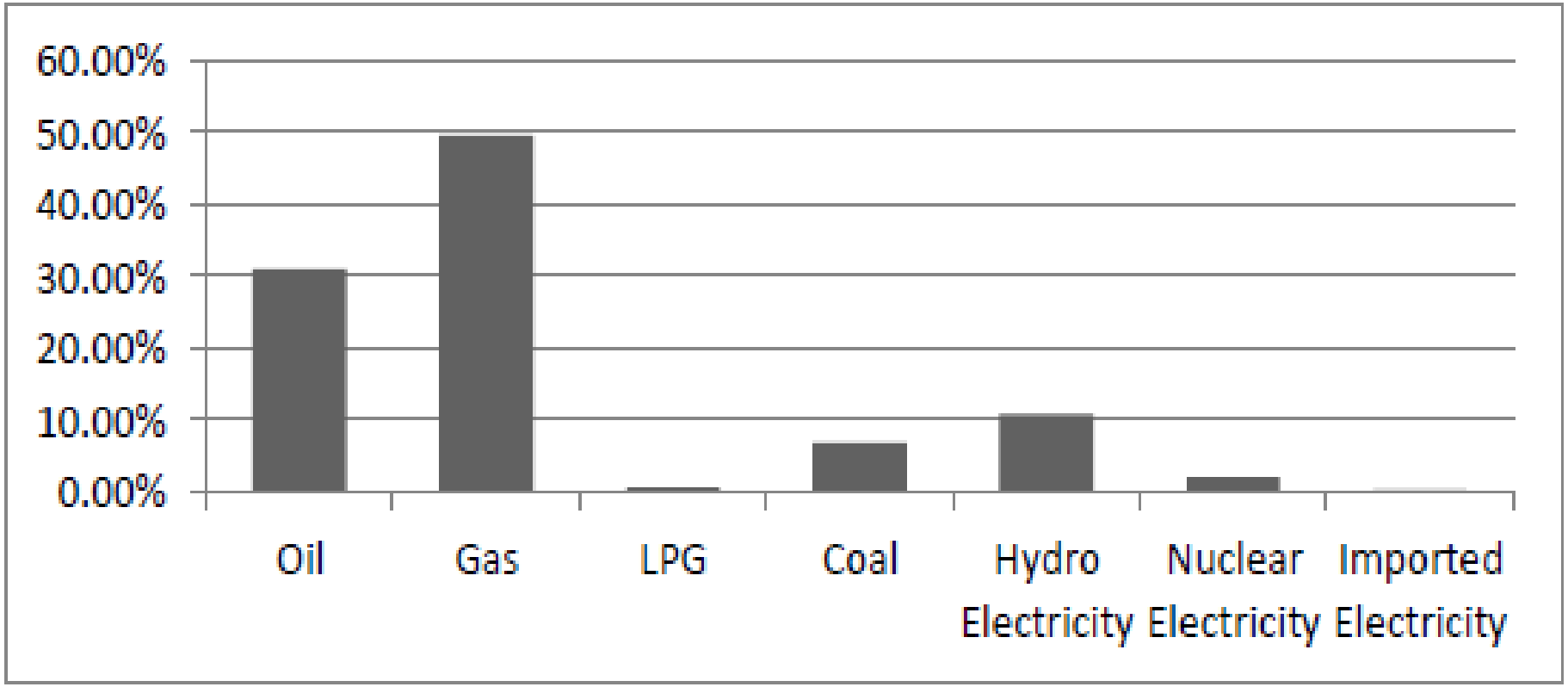
BACKGROUND (CONTD.)



B) PAKISTAN ENERGY SCENARIO

- Heavy dependence on fossil fuels with oil (30.8%), gas (49.8)% and coal (6.6%)
- Low levels of adoption in renewable energy

PAKISTAN PRIMARY ENERGY SUPPLIES BY SOURCE



Source: Pakistan Energy Yearbook (PEY) 2012

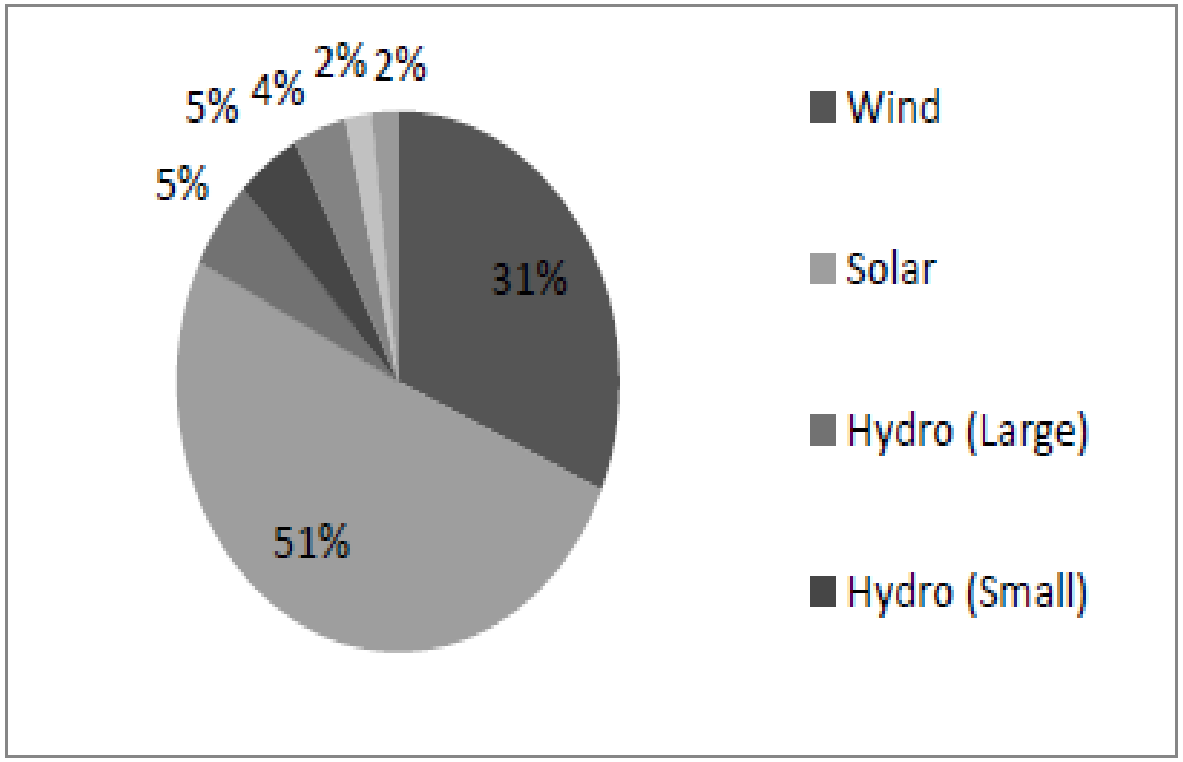
BACKGROUND (CONTD.)



C) RENEWABLE ENERGY IN PAKISTAN

Limited the exploitation of renewable in Pakistan;
Solar (51%)
Wind (31%)

RENEWABLE ENERGY POTENTIAL IN PAKISTAN



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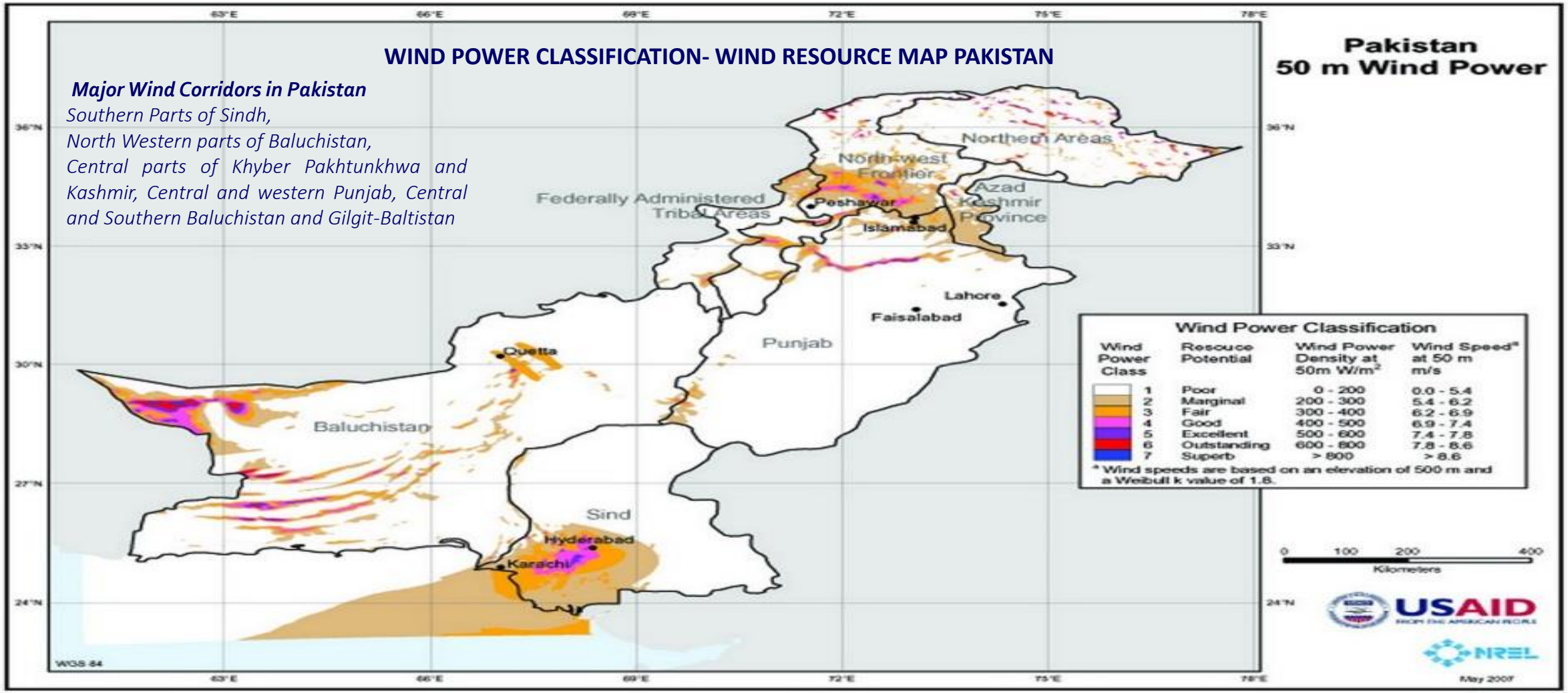
Source: PRES (2011) from AEDB (2008) and NREL (2009)

BACKGROUND (CONTD.)



D) WIND ENERGY IN PAKISTAN



Source: Elliott, 2010

BACKGROUND (CONTD.)



D) WIND ENERGY IN PAKISTAN

- Limited the exploitation of renewable sources in Pakistan
- Renewable sources accounting for less than 1%
- Optimistic estimation of Pakistan wind power potential at 346,000 MW
- Realizable total generative capacity to 131,800 MW

Wind Resource Utility Scale	Wind Class	Wind Power W/m^2	Wind Speed m/s	Land Area km^2	Percent Windy Land	Total Capacity Installed MW
Good	4	400 - 500	6.9 – 7.4	18,106	2.1	90,530
Excellent	5	500 - 600	7.4 – 7.8	5,218	0.6	26,090
Excellent	6	600 - 800	7.8 – 8.6	2,495	0.3	12,480
Excellent	7	> 800	> 8.6	543	0.1	2,720
Total				26,362	3.0	131,800

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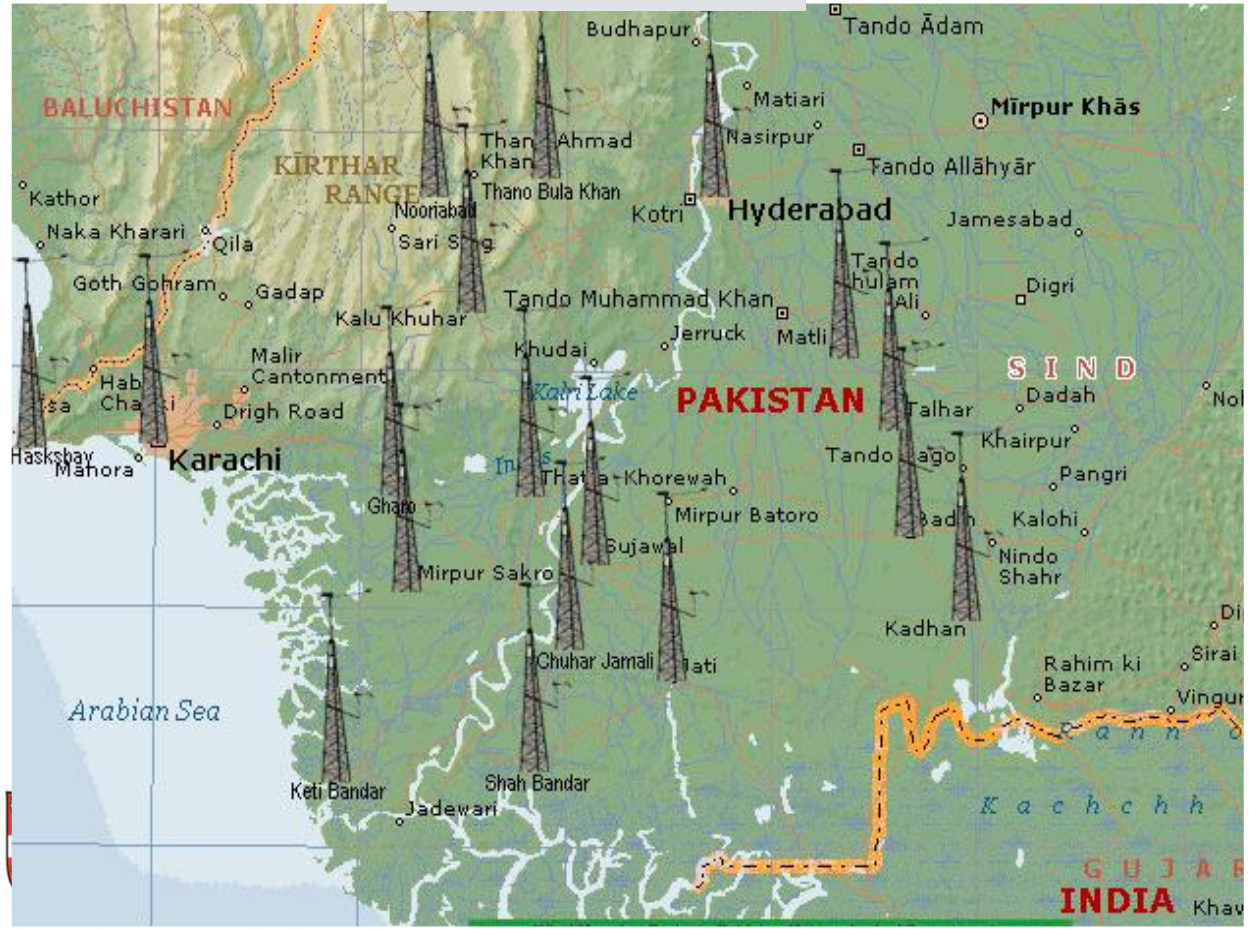
Source: Elliott, D. 2010

BACKGROUND (CONTD.)

E) BLESSED CORRIDOR

From Keti-Bander to Gharo (60km wide) with a generative capacity of 50,000 MW

THE BLESSED CORRIDOR



[Source: Elliott, D., 2010

WIND ENERGY PROJECTS IN PROGRESS IN PAKISTAN

S. No	Project Name(Current)	Capacity
1	FFC Energy Limited	50 MW
2	Zorlu Jhimpir Project	56 MW
3	Foundation Wind Energy	50 MW
4	China Three Gorges	50 MW
5	Foundation Wind Energy II	50 MW
6	Sapphire and Metro	100 MW
	Project Name (Upcoming)	
1	Uch-II	404 MW
2	Grange Power Holdings	Not provided in report

[Source: NPP (2013)]

LITERATURE REVIEW



- Challenges faced by Wind Power Generation initiatives in Pakistan are daunting and their solutions hard to implement given the complications involved in a typically chaotic developing country scenario.
- A logical approach to tackle insightfully an analysis of this kind is to review 'project' case studies searching for reasons of success or failure. This kind of data is mostly confidential and not easily available from public documents. The other approach is to review existing academic research literature around the subject.
- The latter approach was chosen together with a specialized methodology called Collective Synthesis (CS) (Borg 1996; Randolph 2009). CS was used to identify recurrent challenges and create pragmatic solutions 'while maintaining the essay's intellectual progression' (The Writing Centre, 2014) of ideas and their organic development over time specially when considered through a rapidly changing technology landscape.
- To further aid in this endeavour 'country' case studies were examined for gaining further insight and achieving a deeper level of inquiry. The terms 'barriers' and 'developmental challenges' have been used interchangeably.

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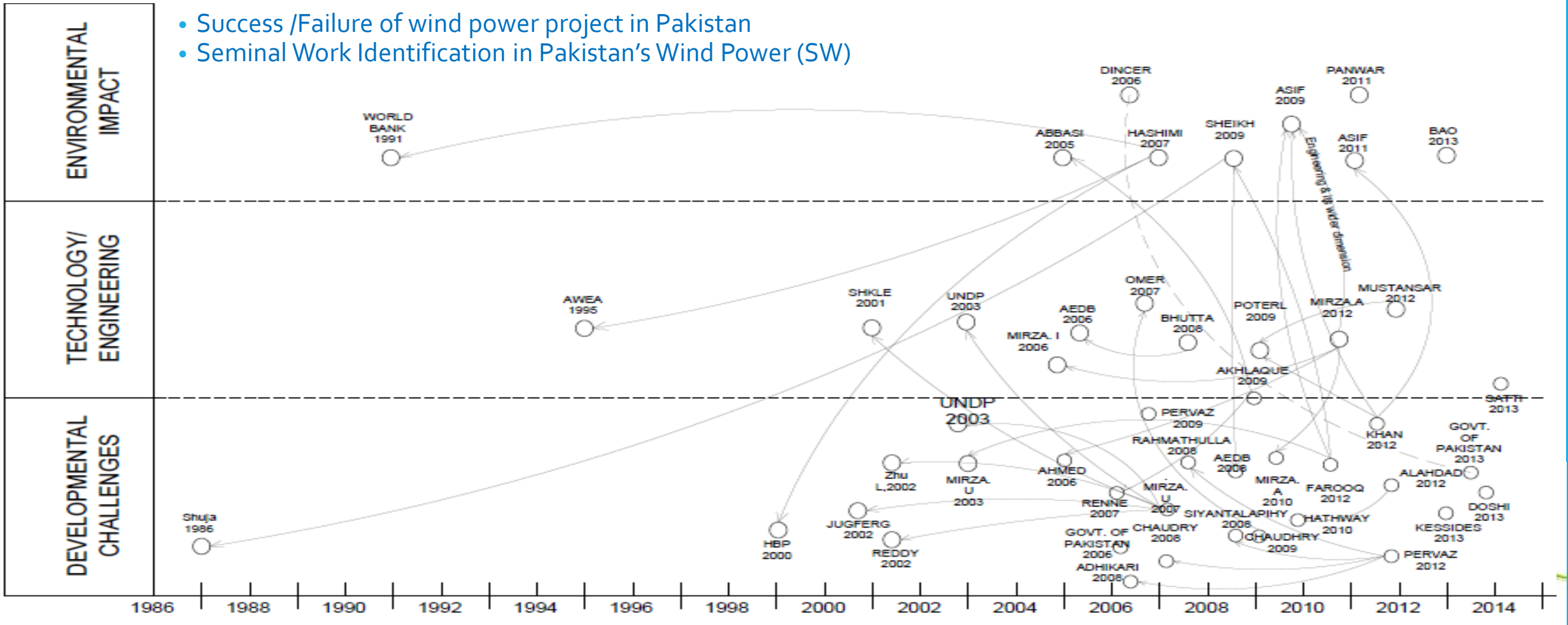
LITERATURE REVIEW (CONTD.)



A) SEMINAL WORK IDENTIFICATION IN PAKISTAN'S WIND POWER (SW)

- Success /Failure of wind power project in Pakistan
- Seminal Work Identification in Pakistan's Wind Power (SW)



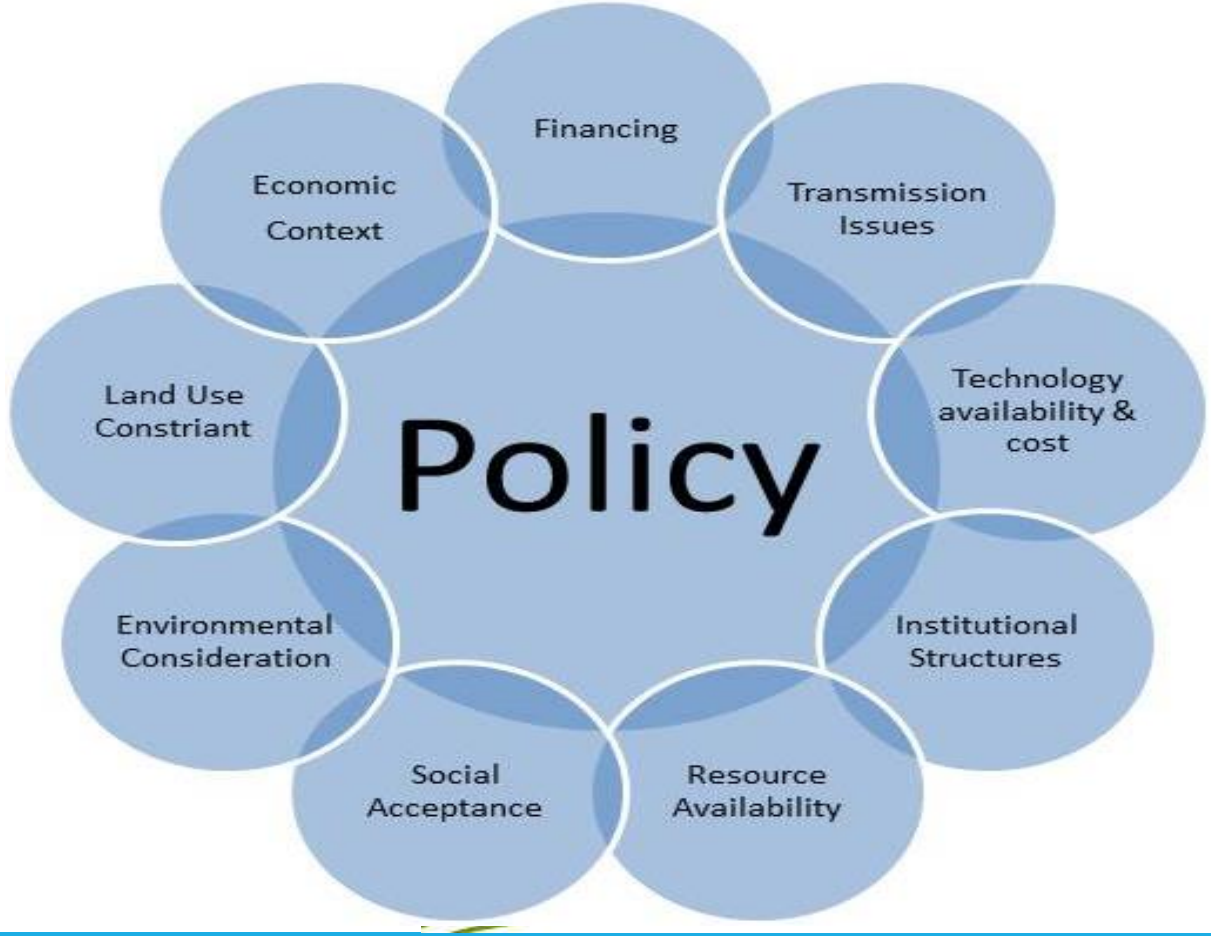
Source: Author's own Construct

LITERATURE REVIEW (CONTD.)



B) DO IDENTIFIED DEVELOPMENTAL CHALLENGES HARMONIZE WITH GLOBAL STUDIES

FACTORS AFFECTING RENEWABLE ENERGY MAARKETS



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Source: Doris, E. Mclaren et. al.

LITERATURE REVIEW (CONTD.)



C) HISTORICAL CONTEXT FOR THE BLESSED CORRIDOR

- Wind power development in Sindh
- Coherent framework for developmental challenges on a national scale
- Technical challenges in wind power development
- Complete **Renewable Energy Policy,** 2006

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LITERATURE REVIEW (CONTD.)



D) TECHNICAL CHALLENGES IN WORD POWER DEVELOPMENT

Identified Challenges or Barriers	Supporting Studies	Identified Solutions	Supporting Studies
Technical Barriers Wind data quality, No Wind Atlas Lack of indigenous manufacturing Long Gestation Period Few successful projects due to assessment weaknesses	Mirza et al.(2012), Sheikh(2009),NPP(2013), Kessides et al. (2013),Mirza & Ahmad et al.(2007), Mirza & Ahmad et al.(2009), Hashmi and Malik et al. (2008), Bhutta(2006), Satti (2013), Iqbal(2008), Pervaz et al. (2012), Zeng et al. (2013), Islam et al. (2006), Islam et al. (2006), Brennand (2001), Junfeng et al. (2012),Deloitte (2013)	Accurate Studies e.g. NREL, Wind masts for monitoring, Improve local manufacturing, increase local knowledge and enhance R& D Prioritize indigenous production Improve reliability of wind speed projections with better equipment Resource Variability risk by Purchaser (on-grid) Technical Wind Project Assessment Framework (China)	Mirza.(2012), Farooq et al.(2012), NPP(2013), Kessides et al. (2013), Mirza & Ahmad et al.(2007),Nayyar (2009) Mirza & Ahmad et al.(2009), Hydro, E. S. (2006), Asif (2009), Khalil (2004), Alahdad, Pervaz et al. (2012), Zeng et al. (2013), Islam et al. (2006), Junfeng et al. (2012), Deloitte (2013), Bhutta (2006) Asif (2011) Kliendam 2012

Source: Various

LITERATURE REVIEW (CONTD.)



E) POLICY AND REGULATORY BARRIERS

Identified challenges or Barriers	Supporting Studies	Identified Solutions	Supporting Studies
Regulation and Policy Lack of Policy- Poor Policy Framework Marginalization of remote areas Welfare tax in Islamic states Non Availability of off grid turbine equipment due to US Govt. tax rebate Citizen participation (only 60% get electricity)	Bhutta (2006), REP (2006), Iqbal (2008), Shiekh (2009) Pervez (2012), Zeng (2013), Islam et al. (2006), Brennand (2001), Junfeng (2012), Nelson (2012) UNESCAP (2008) Allahdad (2012)	International Investor friendly policies Make Wind a high priority sector Comprehensive all encompassing policy Tax exemption for all imported plant machinery and equipment Tax changes to be 'pass through' Long term orientation Carbon Credits for wind projects Purchaser to shoulder transmission cost Infrastructure project financing facility Private Sector Support Recipe for Rural development Income tax, withholding and turnover tax exemption for importers Non Muslims exempted from welfare tax on dividends Sustainability Provisions in Power Policy	REP (2006), Bhutta (2006), Hydro, E. S. (2006), Alahdad (2012), Zeng (2013), Islam et al. (2006), Junfeng (2012), Nelson (2012) Kliendam 2012 NPP (2013)

Source: Author from Collective Synthesis

LITERATURE REVIEW (CONTD.)



F) INSTITUTIONAL BARRIERS

Identified challenges or Barriers	Supporting Studies	Identified Solutions	Supporting Studies
Institutional Barriers Lack of support Poorly defined mandate Disparate govt. bodies Weak institutional arrangement	Mirza et al.(2012), NPP(2013), Mirza & Ahmad et al.(2007), Mirza & Ahmad et al.(2009), Bhutta(2006), Iqbal (2008), Pervaz et al. (2012), Brennand (2001), Nelson et al. (2012)	Improve coordination and cooperation between, government agencies, institutions, ministries and stakeholders. Merge into single entity such as AEDB (one window operation reduces lengthy approval times Simplify approval procedures Seek enhanced support from international Development programs and universities such as Aga Khan Rural Support Program (AKRSP)	Mirza et al.(2012), NPP (2013), Kessides et al. (2013), Mirza & Ahmad et al.(2007), Mirza & Ahmad et al.(2009), Hydro, E. S. (2006), Alahdad, Pervaz et al. (2012), GWEC (2012), Nelson et al. (2012) Bhutta (2006) UNESCAP (2008)

Source: Author from Collective Synthesis

LITERATURE REVIEW (CONTD.)



G) FISCAL AND FINANCIAL BARRIERS

Identified Challenges or Barriers	Supporting Studies	Identified Solutions	Supporting Studies
Financial Barriers Feasibility e.g. Price Competitiveness with Conventional Energy Generation High Set up Cost On Grid and Wheeling Challenge Wind Variability Risk No Venture Funding	Mirza et al.(2012), Sheikh(2009), NPP(2013),Mirza (2007), Mirza & Ahmad et al.(2009), Bhutta(2006), Iqbal(2008), Pervaz (2012), Zeng (2013), Islam (2006), Brennand (2001), Nelson (2012), Deloitte (2013)	Special Government Subsidies and Project Tariff Rationalization Setup Incentives such as BOOT basis Government should ear-mark land for wind energy plants on priority Utility guarantees to buy all power generated Govt. devised fiscal regime Soft loan Wind Risk Coverage by Purchaser Issuing Wind Energy Bonds Explore Equity market Discounted equity to VC firms	Mirza (2012), Farooq (2012), NPP (2013), Kessides. (2013), Mirza & Ahmad et al.(2007), Mirza (2009), Hydro, E. S. (2006), Satti (2013), Iqbal(2008), Hussain et al. (2012), AEDB (2008), Zia et al. (2009), Khalil (2004), Alahdad, Pervaz et al. (2012), Wright (2001), GWEC (2012), Zeng et al. (2013), Islam et al. (2006), Deloitte (2013) Bhutta (2006), REP (2006) Kliendam 2012

Source: Author from Collective Synthesis

LITERATURE REVIEW (CONTD.)



H) MARKET PENETRATION, ENVIRONMENTAL AND MANPOWER BARRIERS

Identified challenges or Barriers	Supporting Studies	Identified Solutions	Supporting Studies
Environmental Challenges Loss of Habitat, Bird Collision, Aircraft safety, interference with telecom systems **Climate Change**	Hashmi, Malik, Yousaf (2007) Nayyar (2009), Panwar (2011),	Build Green Plants Bird Collisions are low Nesting demarcated Fan height limits and no farm near airport Shielding of Interference by turbine Target isolated sites with proven potential	Hashmi, Malik, Yousaf (2007) Panwar (2011),
Lack of Capacity and Training Foreign Experts are expensive	Mirza et al.(2012), Mirza & Ahmad et al.(2007), Mirza & Ahmad et al.(2009), Bhutta(2006), Iqbal(2008), Islam et al. (2006), Brennand (2001), Deloitte (2013)	Trained personnel, training facilities and skilled personnel for Research and Development must be developed Explore JVs with ADB and other donors	Mirza et al.(2012), Mirza & Ahmad et al.(2007), Mirza & Ahmad et al.(2009), Hydro, E. S. (2006), Khalil (2004), Alahdad, Pervaz et al. (2012), Islam et al. (2006),Deloitte (2013) UNESCAP (2008)

Source: Various

LITERATURE REVIEW (CONTD.)



I) GENERAL AWARENESS AND SOCIAL BARRIERS

Identified challenges or Barriers	Supporting Studies	Identified Solutions	Supporting Studies
Lack of Social Awareness & Acceptance Need for increasing availability of public information	Mirza et al.(2012), NPP(2013), Mirza et al.(2007), Mirza & Ahmad et al.(2009), Bhutta(2006), Satti (2013), Pervaz et al. (2012), Zeng et al. (2013), Islam et al. (2006), Brennand (2001),	Awareness of social benefits like emission reduction, local employment and power portfolio diversity Community ownership to encourage citizen participation University to assume leadership role Wind Power Producers should invest in community health and education	Mirza (2012), Harijan (2011), NPP (2013), Kessides (2013), Mirza (2007), Mirza (2009), Hashmi and Malik et al. (2008), Hydro, E. S. (2006), Asif (2009), Alahdad, Pervaz et al. (2012), Zeng et al. (2013), Islam et al. (2006),

Source: Author from Collective Synthesis

DEVELOPMENTAL CHALLENGES IN OTHER COUNTRIES

- Contributions of South Asian Association for Regional Cooperation (SAARC)
- Tradable Green Certificates
- "Ride the wind" policy
- Code For Geological Examination Of Wind Power Projects

CODE FOR GEOLOGICAL EXAMINATION OF WIND POWER PROJECTS

S/N	Name of standard	Standard No.
1	Technical Specifications for Grid-Connecting Design of Large-Scale Wind Farms	NB/T 31003—2011
2	Guidelines for Vibration Condition Monitoring and Diagnosis of Wind Turbine Generator Systems	NB/T 31004—2011
3	Method for Testing Quality of Electric Energy of Wind Farms	NB/T 31005—2011
4	Technical Standard for Steel Structure Corrosion Resistance of Offshore Wind Farms	NB/T 31006—2011
5	Charging Standard for Investigation and Design of Wind Farm Projects	NB/T 31007—2011
6	Quota of Budgetary Estimate for Offshore Wind Farm Project	NB/T 31008—2011
7	Compilation Rules and Charging Standard for Budgetary Estimate of Offshore Wind Farms	NB/T 31009—2011
8	Quota of Budgetary Estimate for On-land Wind Farm Project	NB/T 31010—2011
9	Compilation Rules and Charging Standard for Design Budgetary Estimate of On-land Wind Farms	NB/T 31011—2011
10	Manufacture and Technical Specifications for Permanent Magnet Type Wind Turbine Generators	NB/T 31012—2011
11	Manufacture and Technical Specifications for Doubly Fed Type Wind Turbine Generators	NB/T 31013—2011
12	Manufacture and Technical Specifications for Converters of Doubly Fed Type Wind Turbine Generators	NB/T 31014—2011
13	Manufacture and Technical Specifications for Converters of Permanent Magnet Type Wind Turbine Generators	NB/T 31015—2011
14	Technical Specifications for Battery Energy Storage Power Control Systems	NB/T 31016—2011
15	Technical Specifications for Main Control Systems of Doubly Fed Type Wind Turbine Generator Units	NB/T 31017—2011
16	Technical Specifications for Electric Pitch Control System of Wind Turbine Generator Units	NB/T 31018—2011
17	Corona-Resistant Polyimide Film-Backed Mica Paper Tapes with Glass Fabric for Coil Insulation on Wind Turbine Generators	NB/T 31019—2011
18	Corona-Resistant Polyimide Film for Turn-to-Turn Insulation on Wind Turbine Generators	NB/T 31020—2011

Source: Junfeng, L. (2012) China Wind Energy Outlook

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CONCLUSION



- Wind generation is best developed in combination with hydro (Acker 2011).
- Technological and financial challenges are the most pressing with wind data quality, wheeling and micro-siting issues.
- Technical and financial solutions such as high resolution wind data, indigenous manufacturing of wind turbines, and wind risk assurance by government, as well as greater role of academia and institutional cooperation may proved to be significant in solving wind power problems in Pakistan.
- Technological and financial future energy policy making such as micro-turbine manufacturing, long term loans for renewables and coal tax for setting up a Clean Energy Fund.
- Role of renewables in promoting Rural Education and key success factors in overcoming development barriers
- Financing wind projects through 'tradable' renewable energy certificates.
- Lack of research in Pakistan regarding the effects of climate change on wind generation data
- Crucial time for decision makers to make rewarding decisions and shape policy for the benefit of all.
- If the potential is not fully utilized history will judge it to be a blessed corridor forsaken.

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