Wind Energy Future in Asia

A Compendium of Wind Energy Resource Maps, Project Data and Analysis for 17 Countries in Asia and the Pacific

Full Report, August 2012

Wind power has experienced 26% annual growth in cumulative installations worldwide in the past 5 years and is expected to grow at 16% per annum in the next 5 years, despite increasingly turbulent economic conditions in the short term. Since 2010, Asia has been at the forefront of this growth, as wind energy installations in the region have outstripped both North America and Europe. While China and India have been the main drivers of growth, the projected investments in wind projects in the rest of Asia are expected to exceed US$50 billion between 2012 and 2020. Realizing the full potential of wind energy in the region, however, will require long-term, consistent policies and upgraded transmission and grid infrastructure.

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Acknowledgements

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Preface

The Asian Development Bank's long-term strategy pursues an agenda of inclusive economic growth, environmentally sustainable growth, and regional integration. In line with these goals, the ADB's Quantum Leap in Wind (QLW) initiative assists Developing Member Countries (DMC) with technical, policy and financing aspects of wind power development. QLW comprises USD 2 million in technical assistance financed by the Asian Clean Energy Fund established by the Government of Japan, under the Clean Energy Financing Partnership Facility.

The *Wind Energy Future in Asia Report 2012* is part of this technical assistance and presents a compendium of wind energy data and information for 17 countries in Asia and the Pacific. Lack of readily available information about wind resources, policies, incentives, targets, projects in pipeline and installed capacity is a serious impediment to investment in wind projects. This report is an effort to fill this information void and as such is intended to promote investment in wind energy projects in the select countries.

The report may be used for comparing wind resources, policies and incentives across the 17 countries. Although the data and information is a snapshot as of mid 2012, it should provide a basis for future validation and additional data collection.

This report summarizes the results of the consultations, conference presentations, country status and project presentations, and broad discussion among stakeholders at three QLW workshops conducted by ADB and other workshops conducted by SARI/Energy program of USAID. The accuracy of data and information in the report depends largely on the source. Multiple published sources were consulted, but no independent effort was made to verify the data and information. Readers are therefore advised to verify the data before making investment decisions.

The report contains the following chapters:

- Executive summary contains a comprehensive review of the report.
- Introduction provides information about the wind energy market in the Asia Pacific region and its potential for growth.
- Wind Future by Country section contains 17 chapters, one for each country. Each country chapter contains data and information about: a) the energy sector in general, b) wind energy development — potential, installed capacity and pipeline, c) wind energy policies and tariffs, and d) wind sector key challenges and opportunities.
- Summary section concludes the report with status, challenges and opportunities across the Asia Pacific region.
- Four Appendices: Appendix I contains two cases studies of utility scale wind projects in India and Sri Lanka. Appendix II contains information about Carbon Development Mechanism (CDM) for wind projects. Appendix III contains wind project development checklists of key barriers and solutions. Appendix IV contains bibliography of wind energy related references.

Executive Summary

Asia is the world's largest regional market for wind power and while China and India have been the main drivers of growth, many other countries in the region are now increasingly looking to renewable power to satisfy growing energy demand in a clean and affordable way.

The current state of wind development in the region can be summarized as follows:

- China is the largest market for wind power in the world, adding 17.6 GW of new capacity in 2011 alone. Cumulative wind power capacity has more than doubled in the past 2 years, from 26GW at the end of 2009 to 62GW at the end of 2011. China has installed 258 MW of wind power offshore.

- The wind power market in India grew by 3GW in 2011 to reach a cumulative capacity of 16GW. Since 2010, India has been the 3rd largest market in terms of new installed capacity, trailing China and USA.

- Both China and India have strong manufacturing capacity and are increasingly looking to compete overseas.

- In Japan, there has been renewed interest in wind power partly due to Fukushima Nuclear accident in March 2011, the passing of the Renewable Energy Law in 2011, and revised Feed-in-Tariff announced in April 2012.

- South Korea has strong local manufacturing capacity and the new "Green Growth" strategy should see significant investments in development of 2.5GW of offshore wind power by 2019.

- Bangladesh, Indonesia, Philippines, Sri Lanka, Thailand and Vietnam have established pilot wind projects and renewable energy policies. As of mid-2012, a few commercial wind farms are operational. In Sri Lanka, 30MW is in operation, 30MW is awaiting interconnection, and 30MW is under construction. In Thailand and Vietnam, more than 100MW and 30MW are under construction, respectively. In Philippines, 33MW is currently in operation.

- Afghanistan, Kazakhstan, Mongolia and Pakistan have attractive wind resource potential. As of mid-2012, there are no wind farms. In Mongolia and Pakistan, 50MW wind projects are under construction.

- Many small island countries such as Fiji and Maldives have attractive wind resource with good opportunities for small-scale wind and hybrid plants. The Governments of the Maldives and Fiji are actively promoting wind power.

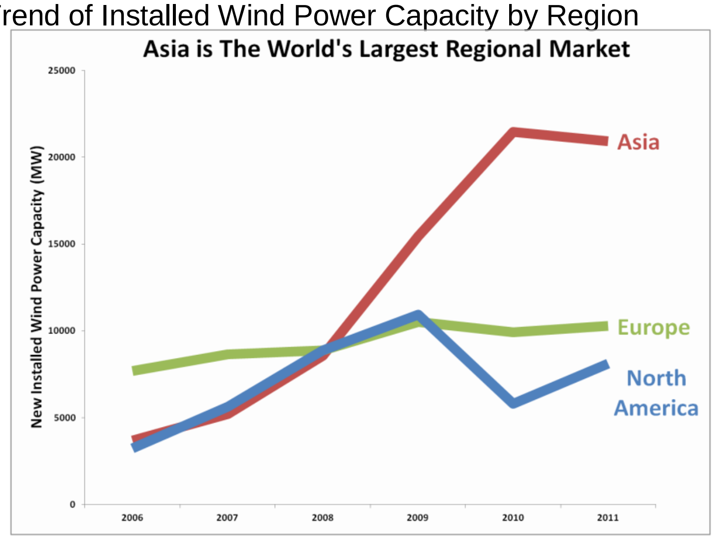
Each country profile in this report presents the opportunities and challenges specific to each country context, however it is clear that in all countries, effective government leadership is imperative to accelerating wind development, particularly in areas of setting appropriate levels of Feed-in Tariff (FIT), accurate wind resource assessment, and coordinated development of grid, transmission and supporting infrastructure in wind-rich regions.

Introduction

Asian Wind Energy Market

For the third consecutive year, Asia is the world's largest regional market for wind power. In 2011, the annual installed wind power capacity in Asia exceeded the combined total for both North America and Europe. As a result of this dynamic growth, Asia will surpass Europe as the world leader in cumulative installed capacity sometime in 2013.

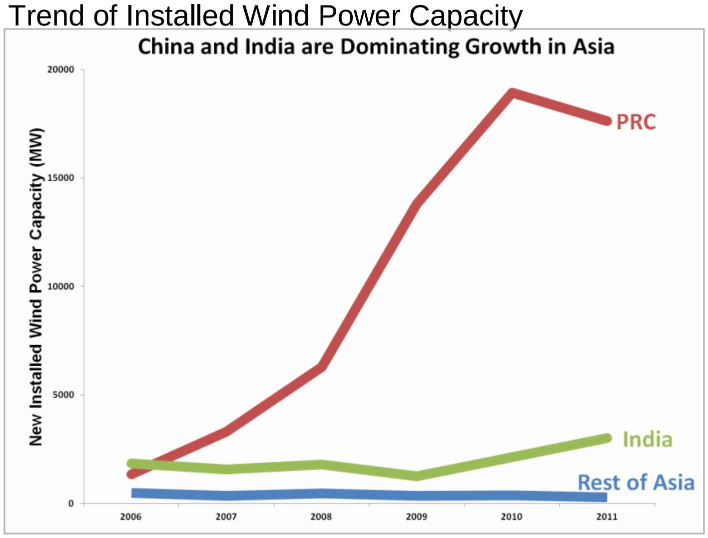
Chart 1: The Global Trend of Installed Wind Power Capacity by Region



Source: Global Wind Energy Outlook, various issues, Global Wind Energy Council (GWEC)

China and India have been main drivers of growth in wind installations, both in Asia and globally While the growth of wind power in other Asian countries has been subdued, many are now increasingly looking to renewable power to provide clean and affordable energy.

Chart 2: The Regional Trend of Installed Wind Power Capacity



Source: Global Wind Energy Outlook, various issues, Global Wind Energy Council (GWEC)

Wind Energy Potential

Wind energy is abundant in most Asian countries yet installed wind capacity is currently only a fraction of realizable potential. In the Asia Pacific region, only 2% of the estimated 5,300 GW potential has been harnessed. With appropriate incentives, installed wind capacity in Asia could increase 8 times in the next 10 to 20 years.

Chart 3: Wind Potential and Capacity in Highest Resource Countries

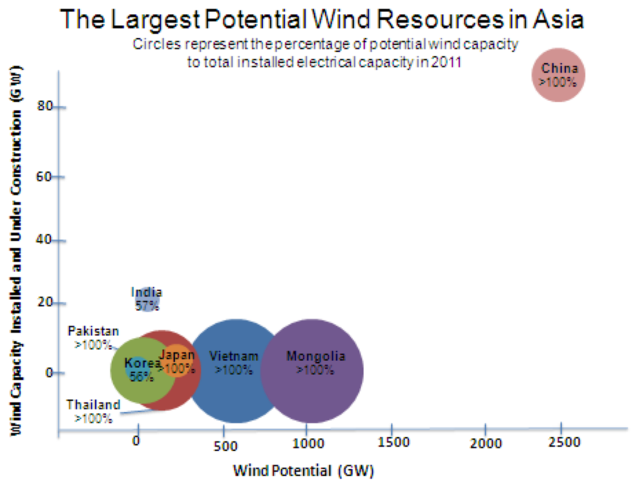
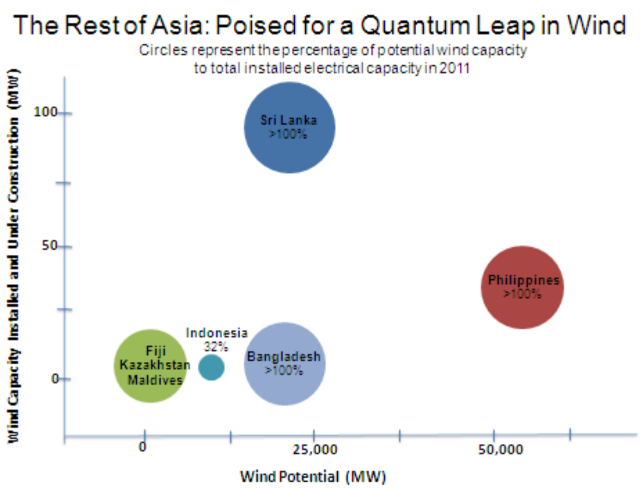


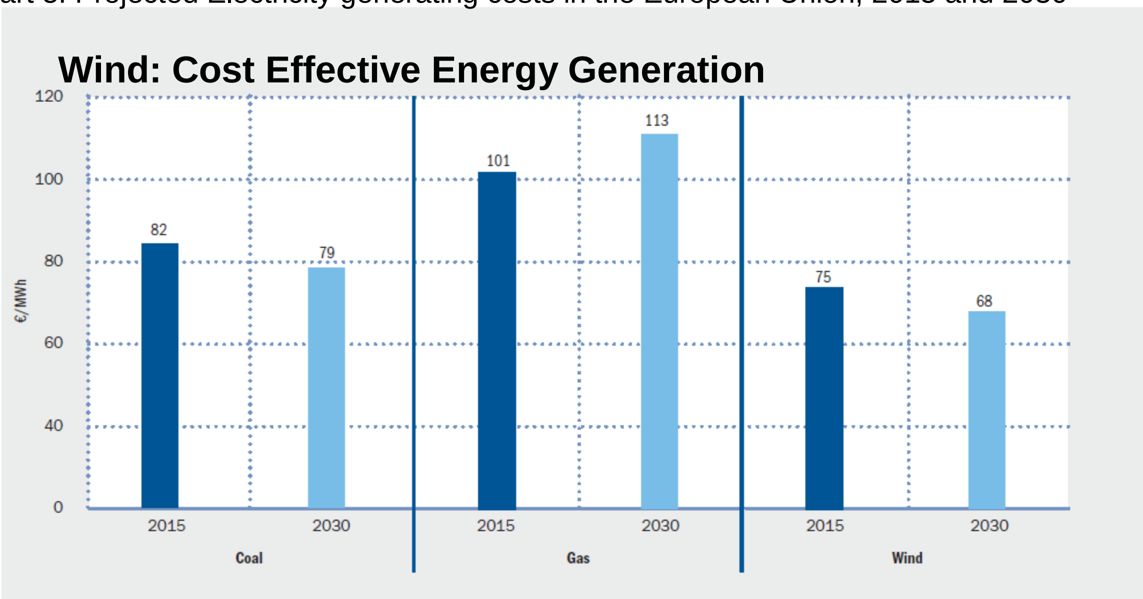
Chart 4: Wind Potential and Capacity in Moderate Resource Countries



A Cheaper, Cleaner Alternative

Wind power not only addresses the challenges of energy security, climate change and access to energy for all, it is also becoming increasingly cost competitive. In markets such as the EU which accounts for carbon emission costs, projected costs indicate that wind is a cheaper alternative to coal and gas (see Chart 5 below). Evidence shows that even when not including externalities, the levelized cost of wind energy is approaching the cost of new build coal-fired energy production. In Brazil, Mexico and New Zealand, wind energy does not enjoy subsidies, yet successfully competes with other forms of energy generation.

Chart 5: Projected Electricity generating costs in the European Union, 2015 and 2030



Source: EWEA, The Economics of Wind Energy, March 2009

Wind Future by Country

1. Afghanistan

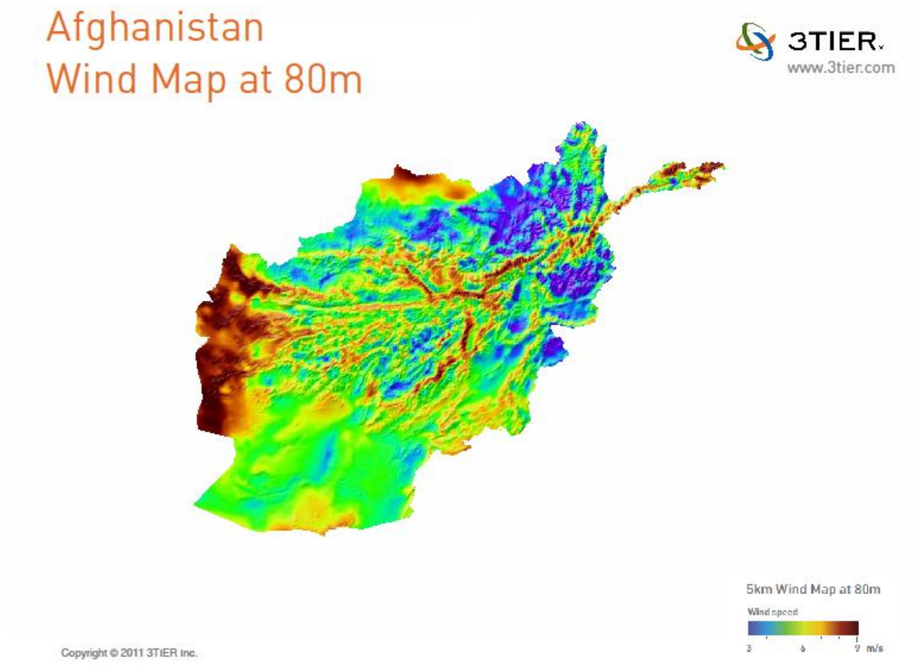


Figure 1: Afghanistan Wind Resource Map at 80 m.

Opportunities:
• Afghanistan is **rich in renewable energy resources** and has a strong culture of commerce and trade. • Hybrid **Small Wind Turbines** with diesel, PV and batteries are promising options to supply electricity for rural electrification or for small grids. • Only 25% of the population has access to electricity. Poorest provinces connected to diesel generators pay as much as **USD 0.50/kWh** • Up **to 8 m/sec** wind speeds are reported. The lowlands in southern and western Afghanistan have around 120 windy days in a year
Challenges:
• **Security** is still the primary issue for donors and the government of Afghanistan • Even in Kabul, the electrical system is islanded due to **non-synchronized power systems**. The other population centers are dispersed and remote and the supporting infrastructure are not in place. • Energy policies and regulations for wind are still not in place

Table 1.1 Demographic and Basic Energy Data	
Population	26.59 million
Area	652,252 sq km
Total electrical energy installed capacity	490 MW (2008)[1]
Electrification rate	25%
Major Sources of Electricity	Oil, Hydro

Table 1.2 Wind Energy Data	
Total realizable wind energy potential	Over 158,000 MW
Areas with ongoing wind resource assessment	-
Areas with good wind resource	Herat, Farah, Balkh and Parwan
Total installed wind energy	400 kW
Total wind energy projects in pipeline	-
Renewable energy target	-
Wind energy target	-

Table 1.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	None

Table 1.4 List of Wind Projects (Installed and Pipelined)				
Name/Location	**Capacity (kW)**	**Year Operational**	**Project Cost (USD Million)**	**Funding Source**
Panjshir Valley Wind Project	75			

Table 1.5 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
Electricity Act of Afghanistan is still being processed	-

Table 1.6 Useful Contacts:		
Government	Electrical and Electronics Department, Faculty of Engineering, Kabul University	**Contact Person:** Prof. Mohammad Shafi Sharifi **Email:** sharifimohd@gmail.com
	Da Afghanistan Breshna Sherkat (Afghanistan Electricity Authority) (DABS)	**Contact Person:** Mohsin Amin, Head of Engineering

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1. "Afghanistan – Status and Development of the Power Sector", presentation by Prof. Mohammad Shafi Sharifi to QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012.
2. "Afghanistan Wind Energy Roadmap Panel Discussion", presentation by Asad Aleem, Energy Specialist, ADB at QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012

[1] US Energy Information Association

2. Bangladesh

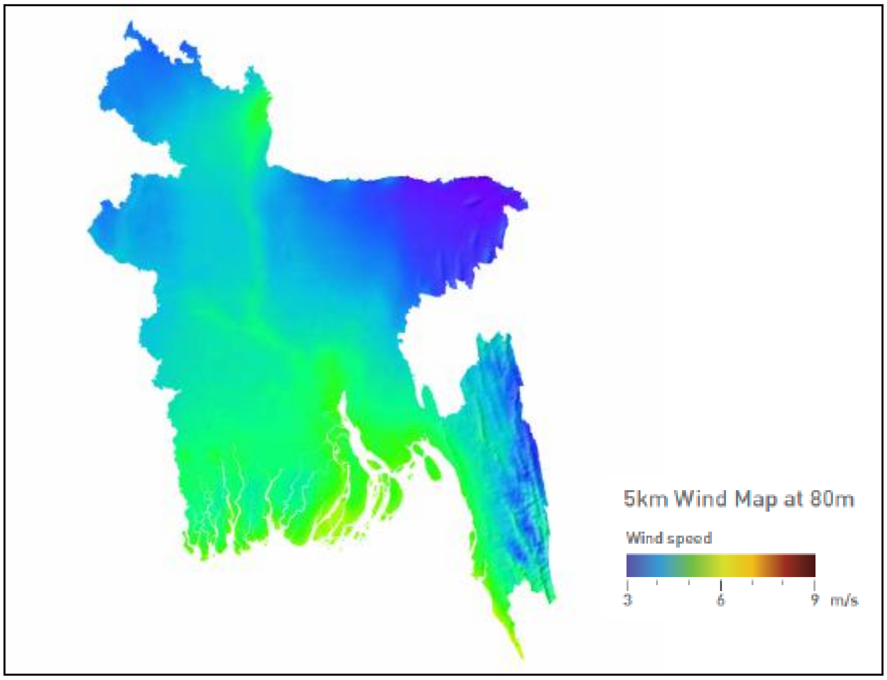

Figure 2: Bangladesh Wind Resource Map at 80m

Opportunities:
• **Small Wind Turbines** (SWT) are widely considered the most appropriate option for Bangladesh given its land use constraints. They can be transported and installed with minimum land and infrastructure requirement. The cost of SWT generated electricity is approximatelyTaka10 – 15/kWh (USD 0.14 – 0.20/kWh)[2], which is significantly less than the cost of solar photovoltaic electricity, which is estimated to be around Taka 50/kWh (USD 0.68/kWh). • **Large Utility-Scale Turbines** may be viable in coastal and higher altitude areas.
Challenges:
• **Detailed wind resource maps** to support the establishment of bankable wind farms are not available for key areas. • Bangladesh's wind regime is characterized by **low average wind speed and high number of extreme weather events (cyclones).** Current wind resource maps indicate highest wind areas have resources in the range of 6 to 6.5m/s at 80m, which would require large rotor turbines for achieving reasonable plant load factor; however, to minimize damage during extreme weather events smaller rotor turbines are required.

[2] USD 1 = Taka 74

- **Weak regulatory incentives** have failed to encourage private sector investments in renewable energy. Till date, majority of the wind energy programs and projects have been sponsored by the government and/or foreign donors.
- **Need to build knowledge and capacity of policymakers** in wind/renewable energy promotion. Lack of experience hinders the creation of policies to support wind power development in the country.

Table 2.1 Demographic and Basic Energy Data	
Population	146.2 million
Area	147,570 sq km
Total electrical energy installed capacity	6,208 MW[3]
Electrification rate	47.0%
Major Sources of Electricity	Natural Gas, Oil, Hydro, Coal

Table 2.2 Wind Energy Data	
Total realizable wind energy potential	Over 20,000 MW[4]
Areas with ongoing wind resource assessment	Barisal, Bogra, Chittagong, Comilla, Cox's Bazar, Dhaka, Dinajpur, Hatiya, Jessore, Khulna, Khepupara, Kutubdia, Mongla, Patenga, Rangamati, Sandip, Sathkira, Sylhet, Teknaf and Thakurgaon.
Areas with good wind resource	Coastal areas and offshore islands
Total installed wind energy	1.9 MW (as of 2011)
Total wind energy projects in pipeline	100 MW
Renewable energy target	5% by 2015 10% by 2020
Wind energy target	200 MW by 2013 1,200 MW by 2020

Table 2.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	Tariff for conventional fuel + 10% Taka14.0/kWh for Diesel (USD 0.19/kWh); Taka 15.5/kWh (USD 0.21/kWh) for wind

Table 2.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Project Cost (USD Million)	Funding Source
1.Kutubdia Wind Power Plant (KWPP)	1	2007	1.8	Bangladesh Power Development Board
2.Feni Grid Connected Wind Power Plant	0.9	2002	1.4	

[3] Bangladesh Power Development Board, as of March 2011
[4] Source: Wind Assessment over Bangladesh has been done independently by RISOE National Laboratory, Denmark using KAMM (Karlsruhe Atmospheric Meso-scale model). It shows several locations with power density of above 200W/m^2 over an area ~ 2,000 km.

3. Parky Saikat Grid Connected Wind Power Plant (along the coast on the Bay of Bengal)	50-200	2013	To be determined	IPP basis
4. Hatiya Solar-Wind-HFO hybrid power plant	7.5	2012-2013	To be determined	ADB

Table 2.5 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
Renewable Energy Policy	2008

Table 2.6 Procedure for Wind Farm Construction	
Procedure	**Agency Involved**
1. Secure Permit	Department of Environment
2. Secure License for doing business	Energy Regulatory Commission
3. Secure Power Purchase Agreement, Power Selling Agreement, Land Lease Agreement, and other requirements to IPPs	Bangladesh Power Development Board

Table 2.7 Useful Contacts:		
Government	Bangladesh Power Development Board	**Contact Person:** Mr. Siddique Zobair, Deputy Secretary, Power Division
		Website: http://www.bpdb.gov.bd/bpdb/
	LGED-Renewable Energy Information Network	**Website:** http://www.lged-rein.org/database.php?pageid=67

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1. "Bangladesh," Presentation by Md. Fazlur Rahman to QLW2 Conference at Asian Development Bank, Manila, June 20-21, 2011.
2. "Country Report of Solar and Wind Energy Resource Assessment – Bangladesh," SWERA, February, 2007.
3. "Policy & Regulatory Review 2010," Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.
4. "Strategy for Promotions and Development of Wind energy in Bangladesh," by Hossain et al. to the National Seminar on Renewable Energy-2011, Dhaka, Bangladesh, April 6-8, 2011.

3. China, People's Republic of

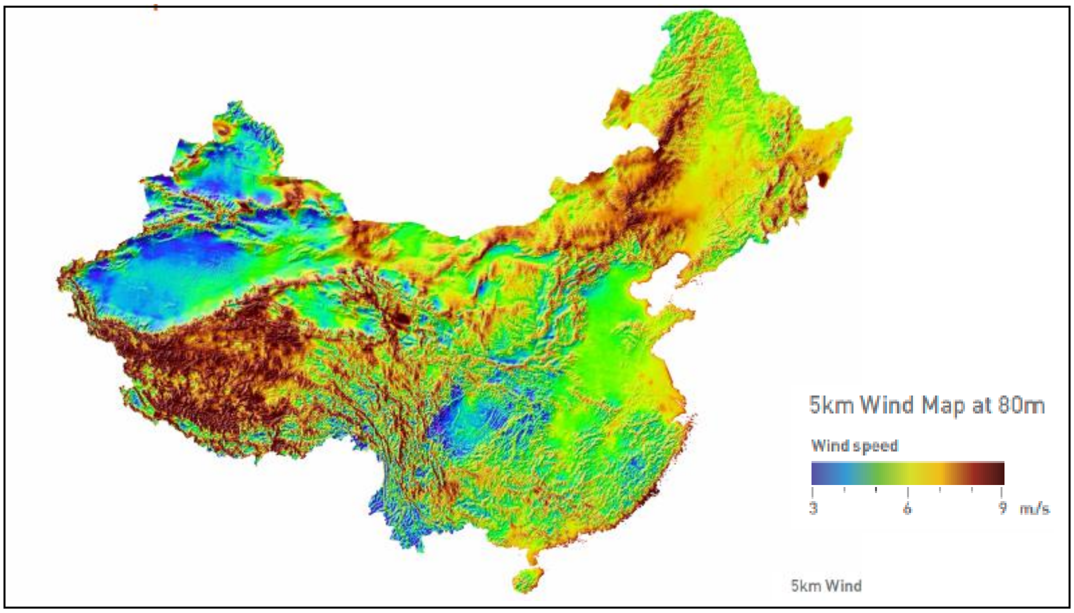

Figure 3: China Wind Resource Map at 80m

Opportunities:

- **Abundant untapped wind resource** in the country can feed **increasing demand for electricity**.
- Locally manufactured and competitively priced supply of wind turbines available from a large base of manufacturers.
- **Ownership and operation of wind power generation is open to the private sector**, while power grids are owned and managed by the Government.
- **Strong policy and regulatory support for wind energy**

Challenges:

- **Need for coordinated grid planning:** New wind power projects must be coordinated with grid planning and expansion. Grid planning has not kept pace with wind power development. The areas with the best wind resource are sparsely populated regions where domestic electricity demand is low. Inner Mongolia, a region with very strong wind resource suffers from severe transmission constraints. High voltage transmission lines are needed to connect these areas with electricity consumers in rapidly developing eastern parts of China.
- **Grid curtailment** is 25% in Gansu**;** 17% in ten windy provinces
- **Need for locally produced wind turbines to be at par with international standards.**

There is an oversupply of wind turbines, with local wind turbine prices approaching RMB 4,000/kW (about USD 619/kW[5]). Quality improvement of the domestic wind turbine manufacturers has not kept pace with the impressive installation rates after almost a decade of experience in producing and installing wind turbines domestically.

Table 3.1 Demographic and Basic Energy Data	
Population	1,339.7million
Area	9,600,000 sq km
Total electrical energy installed capacity	962,190 MW
Electrification rate	99.6%
Major Sources of Electricity	Coal, Hydro, Nuclear, Oil, Gas

Table 3.2 Wind Energy Data	
Total realizable wind energy potential[6]	2,590,000 MW
Areas with good wind resource	Northern and Western China hold particularly large potential for wind power, specifically the provinces of Inner Mongolia, Xinjiang, Gansu, Hebei, Jilin, Liaoning and Heilongjiang.
Total installed wind energy	44,700 MW (as of December 2010) 62,733 MW[7] (December2011)
Total wind energy projects in pipeline	18,339 MW[8] (June 2011) 1 GW off-shore wind concessions have been confirmed: 2 projects of 200MW each and 2 projects of size 300MW each
Renewable energy target	15% by 2020
Wind energy target	Onshore Targets: 100GWby 2015 150-200 GW by 2020 300GW by 2030 Offshore Targets: Target of 5GW by 2015 and 30GW by 2020. 1GW of concessions have been granted Exploitable potential is estimated at 210 GW

[5] USD 1.00 = RMB 6.46
[6]The wind resource map and assessment is done by National Meteorological Administration (Wind and Solar Resource Assessment Center). It is currently undertaking a detailed survey including meso-scale modeling and 400 wind masts for onsite measurements. For onshore wind resources, exploitable potential at 50m height with wind resource coverage of 146.4x10^{4}sq km amounts to 2,380GW. For offshore region at 50m height, wind resource coverage is 20.6x10^{4}sq km and exploitable potential amounts to 210GW (as of 2009).
[77] Source: GWEC: Global Wind Statistics 2012.http://www.gwec.net/fileadmin/images/News/Press/GWEC_-_Global_Wind_Statistics_2011.pdf
[8] Presentation by Hu Runqing of Energy Research Institute , China to ADB-QLW event on 20-21 June,2011

Table 3.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	There are four categories for tariff depending on the region's wind resources ranging from 0.51 RMB/kWh to 0.61 RMB/kWh (USD 0.078-0.094/kWh) applied for 20 years of wind farm operation. For offshore: • 1st round of concession tender USD 0.123/kWh; USD 0.112/kWh, USD 0.109/kWh; • Demonstration projects USD 0.155/kWh
Others	Fixed price depending on wind resource 50% off Value-Added-Tax , Zero income tax for three years and 50% income tax charged for next three years.

Table 3.4 Pipelined Wind Projects by Region[9]

Wind Power Base	2010 (installed, MW)	2015 (planned, MW)	2020 (planned, MW)
Heibei	4,160	8,980	14,130
Inner Mongolia East	4,211	13,211	30,811
Inner Mongolia West	3,460	17,970	38,320
Jilin	3,915	10,115	21,315
Jiangsu	1,800	5,800	10,000
Gansu Jiuquan	5,160	8,000	12,710
Xinjiang Hami	0	5,000	10,800
Total	22,706	69,076	138,086

The Chinese National Energy Administration selected locations from the provinces with the best wind resources and set targets for each of them to be reached by 2020.According to the plan, wind power bases will add up to 138 GW of wind power capacity by 2020, on the assumption that a supporting grid network is established. So far, the Chinese government has confirmed seven GW-scale Wind Power Bases, which amount to 83 projects.

Table 3.5 Relevant Policies

Relevant Policy Supporting Wind Power	Year
1. China announced concession projects, during this round of concession project bidding – the lowest bidder were granted the project.	2003
2. The National Renewable Energy Law became effective, major principles of renewable energy development such as guaranteeing access to the grid for renewable energy producers.	2006
3. Medium and Long Term Renewable Energy Planning in China was issued. The national targets for wind are 5GW by 2010 and 30GW by 2020, which were passed long before the stipulated deadline.	2007
4. New Feed-In Tariff for wind electricity was offered. The value of FIT depends on wind resource and is in the range of RMB 0.51 - 0.61/kWh (USD 0.08-0.09/kWh).	2009
5. After 2010, a new VAT policy was announced in which VAT for wind farm equipments (WTGs) is deductible. Because of this, local government income diminished from wind projects for the first 6-7years.	2010

[9] Source: Global Wind Energy Council

Table 3.6 Local Wind Turbine Manufacturers
1. Sinovel
2. Goldwind
3. Dong Fang Electric
4. United Power
5. Ming Yang Electric
6. Hara XEMC Wind Power
7. Chong Qing Wind Power Equipment
8. Shanghai Electric
9. Zhejiang Windey Wind Generating Engineering
10. CRE Wind
11. Harbin Power

Table 3.7 Project Approval and Permit

Classification	Agency Involved
1. For projects 50MW and below	Provincial Government
2. For projects above 50MW	Central Government

Table 3.8 Useful Contacts

Government	National Energy Administration (NEA)	**Website:** http://www.nea.gov.cn
Research institute	Energy Research Institute, NDRC	**Website:** www.eri.org.cn
Wind Association	Chinese Renewable Energy Industry Association (CREIA)	**Website:**www.creia.net
		Email:creia@creia.net
		Phone:+86 10 68002617
	Chinese Wind Energy Association (CWEA)	**Website**: www.cwea.org.cn
		Email: cwea@cwea.org.cn

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3. "Wind Development in China," Presentation by Hu Runqing to the 2nd Quantum Leap in Wind Workshop at Asian Development Bank, Manila, June 2011.
4. Wind Energy International 2009/2010
5. "Policy & Regulatory Review 2010," Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.
6. "China to boost offshore wind power," http://www.chinadaily.com.cn/business/2011-06/22/content_12754622.htm, June 22, 2011.

4. Fiji Islands

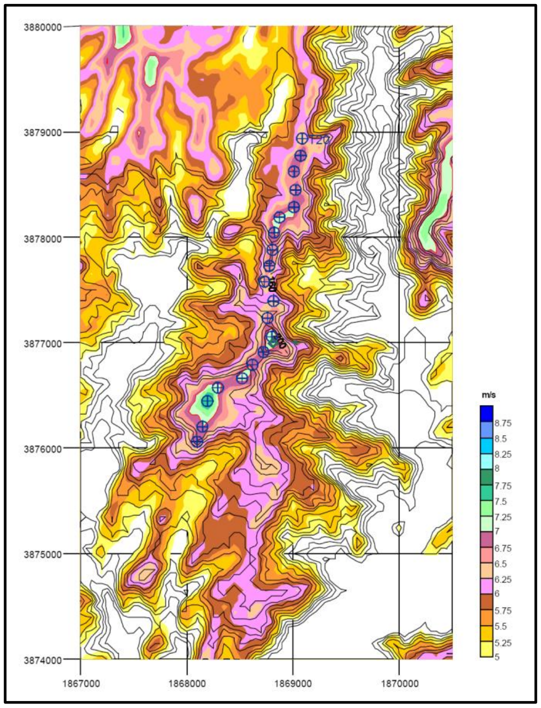

Figure 4: Wind Resource Map of Butoni Wind Farm

Opportunities:
• Wind power provides a cleaner and cheaper alternative to expensive fossil fuel, especially for an island nation. • Limited land and infrastructure provide an opportunity for small-scale wind systems.
Challenge:
• **Need for wind resource assessment**. More accurate wind resource assessment in key locations needs to be conducted to estimate Fiji's overall wind potential. • The existing wind power facility has only achieved 7% capacity factor

Table 4.1 Demographic and Basic Energy Data	
Population	0.85 million
Area	18,270 sq km
Total electrical energy installed capacity	200 MW
Electrification rate	70.5 %
Major Sources of Electricity	Hydro, Oil, Wind

Table 4.2 Wind Energy Data	
Total realizable wind energy potential	Not estimated
Areas with ongoing wind resource assessment	One wind monitoring station installed in Rotuma since June 2007. Sixteen new monitoring stations are planned
Total installed wind energy	10 MW[10]
Total wind energy projects in pipeline	0.5 MW
Renewable energy target	90% by 2015[11]

Table 4.3 Fiscal and Regulatory Incentives	
RE Base Rate	USD0.1457/kWh
Others	All renewable energy projects are exempted from any Government duty.

Table 4.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Funding Source
Butoni Wind Farm	10.0	2007	Fiji Electricity Authority
Ovalau Wind Farm	0.5	2014	

Table 4.5 Relevant Policy Supporting Wind Power
Fiji Electricity Authority (FEA) Mission Statement: Provide 90% of energy through renewable energy (including hydro) resources by 2015.

Table 4.6 Procedure for Wind Farm Construction
1. Acquire land
2. Conduct Environmental Impact Assessment and seek approval from Ministry of Environment
3. Apply for grid connection
4. Apply license to generate and sell electricity
5. Secure Power Purchase Agreements

[10] Wind turbines at Butoni wind farm are tilt-up 225kW Vergnet turbines that may be lowered to the ground in response to cyclone warnings. The turbines are secured to the ground fixed in place until high winds have abated to prevent turbine damage.

[11] Including Hydro

Table 4.7 Useful Contacts:		
Government	Fiji Electricity Authority	**Contact Person:** Hasmukh Patel, CEO
		Website: http://www.fea.com.fj/index.cfm
		Email: Hasmukh@fea.com.fj

References

1. "Fiji Wind Development Status," presentation by Hasmukh Patel to QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012.
2. "Energy Sector Overview," Presentation by Hasmukh Patel to QLW2 Conference at Asian Development Bank, Manila, June 20-21, 2011.
3. "Wind farm," Fiji Electricity Authorization http://www.fea.com.fj/pages.cfm/renewable-projects/wind-farm.html, 2011.
4. "Policy & Regulatory Review 2010," Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.

5. India

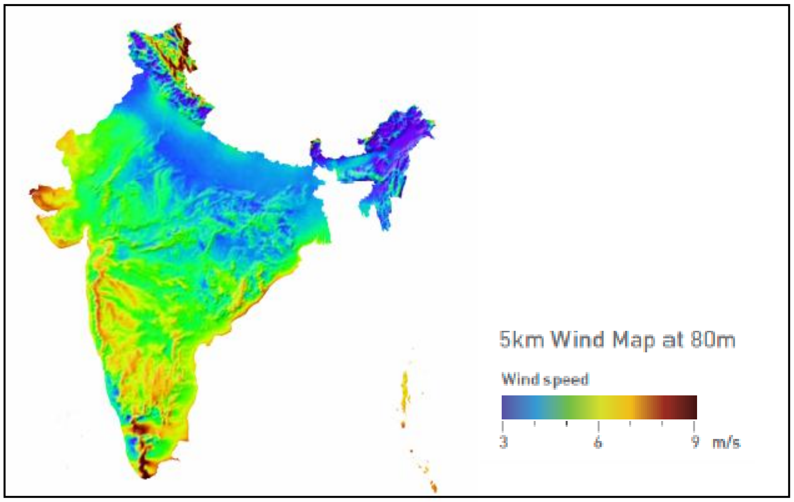

Figure 5: India Wind Resource Map at 80m

Opportunities:
• Access to low cost turbines from competitive local wind turbine manufacturers. India currently has 17 utility scale turbine manufacturers and 9 additional manufacturers slated to enter the market. The current annual wind turbine manufacturing capacity is 9GW (2010/11), which is likely to increase to 17GW in 3 years based on projected growth of 2 to 3GW per year.. Indian manufacturers export USD 1.4 billion[12]worth of wind turbines and spares. • Availability of small to large-scale investments in the wind industry. Wind turbine manufacturers provide turn-key solutions for wind projects. Traditionally, investments were pooled from large numbers of small investors with an appetite for tax credits. Independent Power Producers are increasingly becoming part of the wind energy market as an alternative to manufacturer driven development. • 200 MW demonstration off-shore wind farm planned
Challenge:
• Low wind speed and low average capacity factor. Most locations have class 2 (WPD around 200 to 300 W/m^2) winds while the average capacity factor is in the range of 20%-23% due to significant number of older and smaller WTGs. • Grid integration for rising wind based electricity generation is increasingly a challenge for state electricity utilities, especially in States like Tamil Nadu and Maharashtra. There is an urgent need for proper grid planning and modernization of the grid.

[12] 2010/11 projection, http://www.mydigitalfc.com/power/india-export-14b-worth-wind-turbine-spares-fy11-590

Table 5.1 Demographic and Basic Energy Data	
Population	1,182million
Area	3.28 million sq km
Total electrical energy installed capacity	175,000MW[13]
Electrification rate	66.3%
Major Sources of Electricity	Coal, Hydro, Gas, Oil, Nuclear, and Wind

Table 5.2 Wind Energy Data	
Total realizable wind energy potential[14]	49,130MW[15] 100,000MW[16]
Areas with ongoing wind resource assessment	Wind monitoring was done at 618 sites in these states: Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Jammu and Kashmir.
Areas with good wind resource	Out of 618 sites with wind monitoring, 233 sites were declared as having wind power density (WPD)>200 W/sqm
Total installed wind energy	14,147 MW[17] (March2011) 17,372 MW[18] (March2012)
Total wind energy projects in pipeline	48,000MW (as of March 2012)
Total wind energy projects under construction	3,400 MW
Renewable energy target	15% Renewable Energy by 2020 (National Action Plan on Climate Change (NAPCC)) 5-6% by 2020 target of Draft Integrated Energy Policy approved by Cabinet in 2009
Wind energy target	Estimate of 65,111 MW by 2020, based on NAPCC target[19]
Repowering potential	1,400MW[20]
Offshore potential	20,000MW[21]; no actual detailed assessments have been carried out

[13] http://www.cea.nic.in/reports/monthly/executive_rep/may11/1-2.pdf
[14] Source: Centre for Wind Energy Technology (C-WET)
[15] CWET/MNRE estimate based on 2% land availability across the country
[16] World Institute of Sustainable Energy estimate (2010)
[17] As of March 2011, Source : Ministry for New and Renewable Energy
[18] Source: “India Wind Development Status” presentation by Rajendra V Kharul, QLW3 Workshop, ADB, Manila, June 4-5, 2012
[19] The National Action Plan on Climate Change is not legislation and the target is being contested by MNRE.
[20] World Institute of Sustainable Energy (2010)
[21] Reported in IEA information Paper: Technology Development Prospects for the Indian Power Sector, Feb 2011

Table 5.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff a. SERC (State Electricity Regulatory Commissions) b. Central Electricity Regulatory Commission (CERC) c. Maharashtra d. Madhya Pradesh	a. USD 0.074/kWh to USD 0.117/kWh b. USD 0.067/kWh to USD 0.108/kWh c. USD 0.068/kWh to USD 0.103/kWh d. USD 0.07968/kWh
Renewable Purchase Quotas from 25 SERCs	0.5% to 14%
Tradable renewable energy certificates (RECs)	Floor price of USD 0.033 (INR 1.5/kWh), and Cap price of USD 0.086 (INR 3.9/kWh); recent draft paper by CERC indicates reduction in REC prices for the financial year 2011/12. Producers qualify for REC only if energy is sold at the weighted average cost of power purchase for the utility, which is the wholesale rate[22].
Accelerated Depreciation	80% for wind power projects (available up to March 2012)
Tax Holiday	10 years
Generation Based Incentive	INR 0.5/kWh (USD 0.01/kWh) for wind power projects not availing accelerated depreciation (available up to March 2012, awaiting renewal)
Concessions on import duty	Specified wind turbine components
Allowance of 100% foreign direct investment	All renewable energy generation projects
Central financial fund allocation of $1100 million	For States doing well in grid connected RE
Creation of NCEF (National Clean Energy Fund)	For all RE
Incentives for projects/manufacturing in special economic zones (SEZs)	

Table 5.4 Wind Projects by Region (Installed and Pipelined)[3]		
Name/Location	**Cumulative energy production in million kWh**	**Cumulative installed capacity in MW**
Andhra Pradesh	1,451	138.4
Gujarat	8,016	1,934.6
Karnataka	9,991	1,517.2
Madhya Pradesh	554	230.8
Maharashtra	11,790	2,108.1
Rajasthan	3,938	1,095.6
Tamil Nadu	41,100	5,073.1
Kerala	110	28.0

[22] https://www.recregistryindia.in/pdf/Order_on_Forbearnace__Floor_Price_23-8-2011.pdf

Table 5.5 Relevant Policies	
Relevant Policy/Provision Supporting Wind Power	**Period**
1. Demonstration phase driven by 100% accelerated depreciation and Sales Tax benefits.(Present depreciation 80% and Tax benefit removed)	Prior to 1994/95
2. Energy purchase price by government, tax regime changed, boom-bust cycle	1995 to 2003
3. The Electricity Act of 2003 introduced feed-in tariff, mandatory quotas, de-licensing and open access, which resulted in high growth, addition of 86% of cumulative capacity.	2003 onwards

Table 5.6 Local Capacity [3]					
Turbine Manufacturers	**Rating, kW**	**Drive**	**Speed**	**Generator**	**Class**
Established:					
Enercon	800	Gearless	Variable	Sync	II-S
GE Wind	1,500	Geared	Variable	DFiG	IIA
Suzlon	1,250	Geared	Dual	Async	II
Suzlon	1,500	Geared	Variable	Async	IIIA
Suzlon	2,100	Geared	Variable	Async	IIA
Vestas India	1,650 / 1,800	Geared	Variable	Async	IIB/IIIA
RegenPowertech	1,500	Gearless	Variable	Sync	IIIA
Gamesa	850 / 2,000	Geared	Variable	DFiG	IIIB/IIIA
Leitner-Shriram	1,350 / 1,500	Gearless	Variable	Sync	IIA/IIIA
Kenersys India	2,000	Geared	Variable	Sync	IIA
WinWind	1,000	Geared	Variable	Sync	IIIB
Global Wind Power Ltd/Norwin	750	Geared	Fixed	ASync	IIB
Global Wind Power Ltd/Fuhrlander	2,500	Geared	Variable	ASync	IIIB
Emerging:					
Essar Wind	1,500	Geared	Variable	DFiG	IIIA
Global Wind Power Ltd.	2,000 / 2,500	Gearless	Variable	Sync	IIIA
Inox Wind Ltd.	2,000	Geared	Variable	DFiG	IIIB
RRB Energy	1,800	Geared	Variable	Async	II/III
Siemens	2,300	Geared	Variable	Async	NA
Xyron Technologies Ltd.	1,000	Gearless	Variable	Sync	IIB

Table 5.7 Procedure for Wind Farm Construction		
Procedure	**Agency Involved**	**Notes**
1. Site selection from identified potential sites	Ministry of New and Renewable Energy (MNRE)/ Centre for Wind Energy Technology (C-WET)	Sites must have mean annual wind power density of at least 200W/m^2 or more at 50m height.
2. Follow guidelines for establishing wind farms	MNRE	
3. Seek clearance for turbines	Revised List of Models and Manufacturers (RLMM) Committee	Type certification
4. Acquire No Objection Certificates	State Electricity Boards or State Nodal Agencies	

Table 5.8 Useful Contacts:		
Government	Ministry of New and Renewable Energy	**Website:** mnre.gov.in
Wind Association	Indian Wind Energy Association	**Website:** inwea.org
	Indian Wind Turbine Manufacturers Association	**Website:**IndianWindPower.com

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3. "India Market Overview," Presentation by G.M. Pillai to QLW2 Conference at Asian Development Bank, Manila, June 20-21, 2011.
4. "Indian Wind Energy Outlook 2011," Global Wind Energy Council, http://www.gwec.net/fileadmin/images/India/IWEO_2011_FINAL_April.pdf, April 2011.
5. http://www.iea.org/papers/2011/technology_development_india.pdf4.

6. Indonesia

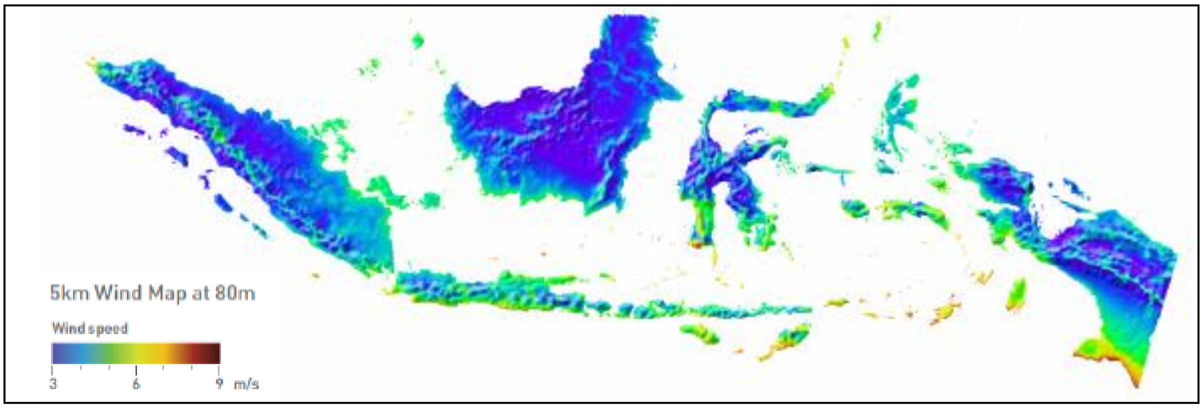

Figure 6: Indonesia Wind Resource Map at 80m

Opportunities:
• **Small wind farms are ideal in areas south of Papua and small southeastern islands** where wind potential is good. • Smaller islands will require development of wind-solar and wind-diesel systems. • **The country is looking into renewable energy** such as wind power to address the country's low electrification rate. The Government is intent on developing small- and medium-scale wind farms ranging from 10kW to 100MW.
Challenges:
• Local technical skills are needed to maintain small wind systems in remote off-grid areas. • Cost-efficient turbines that have good track record are needed in similar island setting.

Table 6.1 Demographic and Basic Energy Data	
Population	234.2 million
Area	1,919,440 sq km
Total electrical energy installed capacity	29 GW[23]
Electrification rate	65 %[24]
Major Sources of Electricity	Coal, Oil, Gas, Hydro, Geothermal

Table 6.2 Wind Energy Data	
Total realizable wind energy potential	9,300MW[25]
Areas with good wind resource:	Sumba and West Timor. Total of 130 sites mapped (wind speed above 5m/s at 50m) in the areas of Nusa Tenggara Timur, Nusa Tenggara Barat, Sulawesi Selatan and the coastal areas of South Java.
Total installed wind energy	0.5 MW[26]
Renewable energy target	5 % (biomass, nuclear, hydro, solar, and wind) by 2025
Wind energy target	255 MW by 2025

Table 6.3 Fiscal Incentive	
Wind Feed-in-Tariff (Rate to be paid by PLN to Sukabumi)	USD 0.092/kWh

Table 6.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Purpose / Description
1. Small PilotWindEnergyVillage Project at Jepara – Central Jawa, Nyamuk Island, Karya Island, Oitui	0.069	1991	Used for household lighting and water pumping.
2. Small Pilot Samas Village Yogyakarta, KuwaruVillage, Sundak and Giliyang Madura	0.064		Used to power compressor for shrimp breeding, water pumping, and lighting households.
3. HybridSystemWind-PV and Diesel at Rote Ndao East NusaTenggara and Wini North Timor Tengah			
4. Hybridsystemwind-PV at Girisari, Bali			Used to power Indosat BTS
5. Small isolated grid connection in NusaPenida Island Bali	0.735	2009	
6. Sukabumi, West Java Phase 1 (Total 30 MW)	10.000	2012	Viron Energy

[23] Wind Energy International 2009/2010
[24] World Bank
[25] Source: The National Institute of Aeronautics and Space (LAPAN). Average wind speed is 3-5m/s.
[26] REEEP 2010

Table 6.5 Relevant Policies	
Relevant Policies Supporting Wind Power	**Year**
1. The Green Energy Policy provided guidelines for the development of renewable energy including regulatory instruments.	2004
2. 'White Paper' for National Energy Management (2005 – 2025): Accelerates the energy diversification and support electrification projects. It contains the national strategy that focuses on energy.	2005
3. The Electricity law: It secures sustainable energy supplies, promotes conservation and use of renewable energy resources. The regulation set by this law "Purchasing Price by PT PLN of Generated Electricity from Small and Medium Scale Renewable Energy Power Plant or Excess Power" aims to enhance the electricity generated by small and medium scale of renewable energy power plant or excess power to be purchased by state owned company, regional owned company, and cooperatives. The law provides for differing tariffs in different regions depending on the cost of supply. Currently there is no separate tariff for wind power.	2009
4. In G20 Finance Ministers and Central Bank Governors Summit, Indonesia pledged to reduce GHG emissions from forestry and the energy sector by 26% through domestic effort, and by up to 41% through cooperation with other countries.	2009

Table 6.6 Useful Contacts:		
Government	Ministry of Energy and Mineral Resources	**Contact Person:** Ir. Kardaya Warrika, Directorate General of New Energy, Renewable, and Energy Conservation
		Websites:http://www.esdm.go.id/index-en.html?,http://www.ebtke.esdm.go.id/home
Wind Association	Indonesia Wind Energy Society (IWES)	**Email:**ripnoms@yahoo.com, brsckd@centrin.net.id

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1. Wind Energy International 2009/2010, World Wind Energy Association, 2009.
2. "Indonesia Wind Power Potential," Prepared by Soren Karkov, DNV, June 2011.
3. "Policy & Regulatory Review 2010," Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.
4. International Energy Agency Website: http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=ID

7. Japan

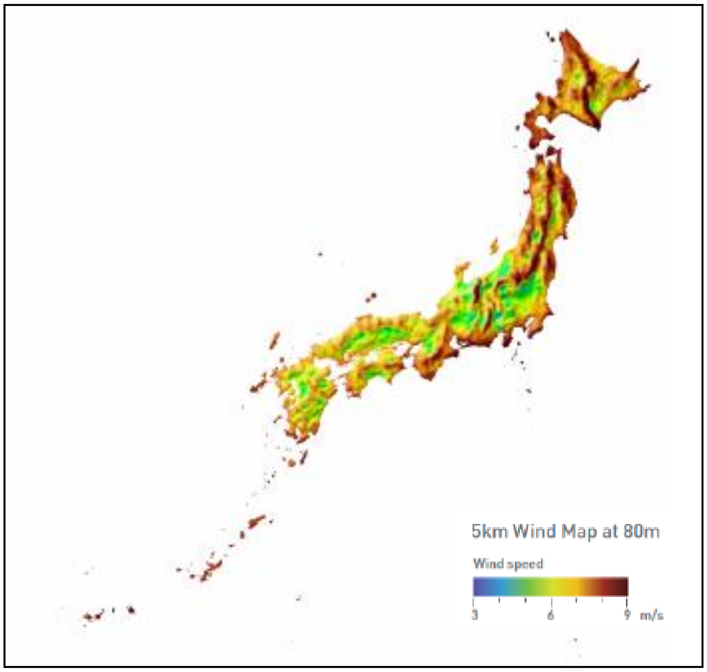

Figure 7: Japan Wind Resource Map at 80m

Opportunities:

- **Generous renewable energy incentives have been announced in a shift away from nuclear power.** Attractive Feed-in-Tariffs were approved in June 2012 and the government expects capacity of wind to increase by 500MW by end of March 2013[27].
- **Wind power installations have withstood the impacts of natural disasters** that often occur in Japan. A recent example is of a wind farm close to Fukushima that has survived the impacts of the March 2011 earthquake and tsunami. This is likely to be a favorable factor in future technology choices.

Challenges:

- **Geographic location prone to extreme natural hazards**. Japan is prone to typhoons, winter lightning, and earthquakes which increase the cost of installation.
- Regulatory, technical, complex planning process and grid connection problems hamper wind power installations.

[27] Japan approves renewable subsidies in shift from nuclear power, June 18 2012, Source: http://in.reuters.com/article/2012/06/18/us-energy-renewables-japan-idINBRE85H00Z20120618

Table 7.1 Demographic and Basic Energy Data	
Population	127.4 million
Area	377,914sq km
Total electrical energy installed capacity	275.5 GW[28]
Electrification rate	100%[29]
Major Sources of Electricity	Coal, Gas, Nuclear, Oil, Hydro, Biomass, Waste

Table 7.2 Wind Energy Data	
Total realizable wind energy potential	280GW (onshore)[30] 1,600GW (offshore)
Areas with ongoing wind resource assessment	Refer to the Ministry of Environment Wind Map[31]
Areas with good wind resource	Tohoku and Hokkaido in the north of Japan and Kyushu in the south
Total installed wind energy	2,410 MW[32](March 2011) 2,501 MW[33] (December 2011)
Total wind energy projects in pipeline	175MW (June 2011)
Renewable energy target	20% of final energy consumption by 2020[34]
Wind energy target	1.35% by 2010 1.63% by 2014

Table 7.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	JPY 57.75/kWh (USD 0.73/kWh)[35] for wind projects below 20kW, fixed for 20 years[36] JPY 23.1/kWh (USD 0.29/kWh)[37] for wind projects above 20kW, fixed for 20 years[38]

Table 7.4 List of Wind Projects from Major Developers

Name/Location	Capacity (MW)	Year Operational
Wind Farms by Ereus Energy (as of November 2011):		
1. Tomamae Green Hill Wind Park, Hokkaido	20.00	1999
2. Hamatonbetsu, Hokkaido	3.97	2001
3. Enbetsu Wind Park, Hokkaido	2.97	2001
4. Soya Misaki Wind Farm, Hokkaido	57.00	2005
5. Date Wind Farm, Hokkaido	10.00	2011

28 Japan Wind Power Association (JWPA)
29 Japan Wind Energy Association (JWEA)
30 Ministry of Environment, 21 April 2011.
31 Ministry of Environment Wind Map as of June 2011: http://www.env.go.jp/earth/ondanka/rep/index.html
32 Japan Wind Power Association (JWPA)
33 Source: GWEC: Global Wind Statistics 2011.
34 Ministry of Economy, Trade and Industry website: http://www.meti.go.jp/english/policy/energy_environment/renewable/ref1001.html
35 USD 1.00 = JPY 79.74
36 Japan approves renewable subsidies in shift from nuclear power, June 18 2012, Source: http://in.reuters.com/article/2012/06/18/us-energy-renewables-japan-idINBRE85H00Z20120618
37 USD 1.00 = JPY 79.10
38 Japan approves renewable subsidies in shift from nuclear power, June 18 2012, Source: http://in.reuters.com/article/2012/06/18/us-energy-renewables-japan-idINBRE85H00Z20120618

6. Iwaya Wind Farm, Aomori	32.50	2001
7. Shitsukari Wind Farm, Aomori	19.25	2003
8. Mameda Wind Farm, Aomori	10.50	2003
9. Odanosawa Wind Farm, Aomori	13.00	2004
10. Eurus Hitz Kitanosawa Cliff Wind Farm, Aomori	12.00	2007
11. Noheji Wind Farm, Aomori	50.00	2008
12. Tashirotai Wind Farm, Akita	7.65	2002
13. Nishime Wind Farm, Akita	30.00	2004
14. Kamaishi Wind Farm, Iwate	42.90	2004
15. Takine Ojiroi Wind Farm, Fukushima	46.00	2010
16. Satomi Wind Farm, Ibaraki	10.02	2006
17. Aridagawa Wind Farm, Wakayama	13.00	2009
18. Shin Izumo Wind Farm, Shimane	78.00	2009
19. Okawara Wind Farm, Tokushima	19.50	2009
20. Seto Wind Farm, Ehime	8.00	2009
21. Kihoku Wind Farm, Kagoshima	20.80	2004
22. Kunimiyana Wind Farm, Kagoshima	30.00	2011
Wind Farms by J Power (as of March 2010):		
23. Tomamae Wind Farm, Hokkaido	30.60	2000
24. Nikaho Kogen Wind Farm, Akita	24.75	2001
25. Tokyo Bayside Wind Power	1.70	2003
26. Green Power Kuzumaki, Iwate	21.00	2003
27. Nagasaki-Shikamachi	15.00	2005
28. Aso-Nishihara, Kumamoto	17.50	2005
29. Tahara Bayside, Aichi	22.00	2005
30. Setana Seaside, Hokkaido	12.00	2005
31. Koriyama-Nunobiki Kogen, Fukushima	65.98	2007
32. Sarakitomanai, Hokkaido	14.85	2001
33. Yokihi No Sato, Yamaguchi	4.50	2003
34. Minami Oosumi, Kagoshima	26.00	2003 and 2004
35. Ichimokusan, Kumamoto	8.50	2007
36. Shimamaki, Hokkaido	4.50	2000
37. Tahara, Aichi	1.98	2004
38. Irouzaki, Shizuoka	34.00	2010
39. Hiyama Kogen, Fukushima	28.00	2010
40. Awara, Fukui	20.00	2010

Table 7.5 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
1. The Basic Energy Plan: Target RE share is 20% by 2020. Second revision emphasizes offshore wind farm technology as important for future energy policy.	2003
2. Renewable Portfolio Standard (RPS) Law: Aims to increase renewable energy production to 12.2TWh (1.35% of total electricity supply) by 2010; wind target 3,000MW.	2003
3. Cool Earth Innovative Energy Technology Program: A cooperative initiative with major greenhouse gas emitters to reduce emissions by 50% from current levels by 2050. It includes Energy Technology Roadmap.	2007
4. Set a target to increase the share of renewable energy to 20% of total primary energy supply by 2020 to help achieve the mid-term emission reduction objectives.	2009
5. Feed-In Tariffs Bill for approval in 2012.[39]	2011/2012

Table 7.6 Local Capacity	
Company Name	**Type**
1. Eurus Energy Holdings Co.	Developer
2. J Power Co.	Developer
3. Japan Wind Development Company	Developer
4. Mitsubishi Heavy Industries Ltd.	Wind Turbine Manufacturer (2.4MW and 1MW)
5. Japan Steel Works Ltd. (JSW)	Wind Turbine Manufacturer (2MW)
6. Fuji Heavy Industries Ltd.(FHI, Subaru)	Wind Turbine Manufacturer (2MW)
7. J Tekt Co.	Bearing Manufacturer
8. NSK Co.	Bearing Manufacturer
9. NTN Co.	Bearing Manufacturer
10. Hitachi, Co.	Wind Turbine Generator Manufacturer
11. Meidensya, Co.	Wind Turbine Generator Manufacturer
12. Yasukawa Electric Co.	Wind Turbine Generator Manufacturer

[39] Submitted to the Diet on 11th March, 2011, same day the Great East Japan Earth Quake occurred.

Table 7.7 Procedure for Wind Farm Construction	
Procedure	**Agency Involved**
1. If location is in National Park	Ministry of Environment
2. Auction by Electric Company	Electric Company
3. Environmental Assessment	Ministry of Environment
4. Secure permit for conversion of land from agriculture to commercial.	Ministry of Agriculture, Forestry and Fisheries
5. Secure permit if within Guard Forest.	Ministry of Agriculture, Forestry and Fisheries
6. Secure permit for offshore location within fishing area.	Fishermen's Association

Table 7.8 Useful Contacts:		
Government	Ministry of Economy, Trade and Industry	**Website:** http
	New Energy and Industrial Technology Development Organization (NEDO)	**Website:** http://www.nedo.go.jp/english/
Wind Associations	Japan Wind Power Association (JWPA)	**Website:**www.jwpa.jp
		Email:info@jwpa.jp
		Phone:+ 81 3 5297 5578
	Japan Wind Energy Association (JWEA)	**Website:** http
		Email: jwea@jsf.or.jp
		Phone: + 81 298 58 7275

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2. "Renewable Energy Technology White Book," New Energy and Industrial Technology Development Organization (NEDO), July 2010.
3. "Study of Potential for the Introduction of Renewable Energy," The Ministry of Environment of Japan, March 2011 (Japanese).
4. "FY2011. Offshore Wind Power Generation Technology Research and Development: Call for Proposal," New Energy and Industrial Technology Development Organization (NEDO), http://www.nedo.go.jp/content/100149662.pdf, June 2011 (Japanese).
5. Ereus Energy website (http://www.eurus-energy.com/english/project_01.html).
6. J Power Factbook 2010 (http://www.jpower.co.jp/english/ir/pdf/fact10e.pdf).

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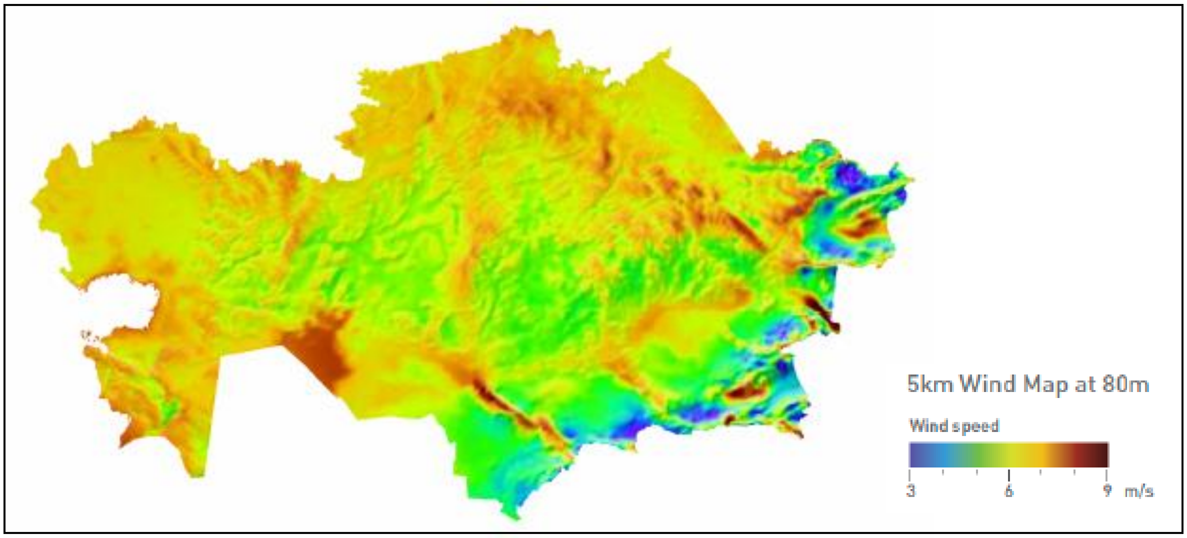

Figure 8: Kazakhstan Wind Resource Map at 80m

Opportunity:
• **Country-wide good wind potential.** Large territories of Kazakhstan are appropriate for installation of wind-power plants, as shown in Figure 7. Kazakhstan has large areas with Class 3 and above wind speeds. Of the ten best sites, Djungar Gates and Sheleksky Corridor are the most favorable due to their proximity to existing transmission lines, positive correlation of wind season with energy demand, and a good demand for electricity.
Challenges:
• Utilizing wind power is not a priority as cheap electricity is available from coal and gas power plants. • There is a lack of legislative and regulative support for wind that takes into account benefits to the environment and society.

Table 8.1 Demographic and Basic Energy Data	
Population	16.1 million
Area	2,724,900sq km
Total electrical energy installed capacity	18,800MW[40]
Major Sources of Electricity	Coal, Gas, Oil, Hydro

Table 8.2 Wind Energy Data	
Total realizable wind energy potential	2,000 MW can be utilized until 2024[41]
Renewable energy target	More than 1% by 2014

Table 8.3 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
1. Ratification of United Nations Framework Convention on Climate Change (UNFCCC)	1995
2. The electricity generation sector was opened to private investment	Mid 1990s
3. Kazakhstan became a signatory to the Kyoto Protocol	1999
4. Electricity Law: Power supply sector was deregulated	2004
5. Law ratifying the Kyoto Protocol. Kazakhstan committed towards achieving Greenhouse Gas (GHG) emissions reduction relevant to the base year (1990): -15% by 2020 and -25% by 2050.	2009
6. Energy Sector Development Program 2010-2014	2010
7. Creation of an internal cap-and trade system to encourage business to reduce GHG emissions and to cover a portion of their expenditures on environmental protection measures.	2010
8. State Program for Industrial-Innovative Development of Kazakhstan. The program targets 1 billion kWh per year renewable energy capacity installation by 2014.	2010

Table 8.4 Useful Contacts:		
Government	Ministry of Environmental Protection	**Contact:** Makazhanova Aida
		Website: http://www.eco.gov.kz
		Email: makazhanova@eco.gov.kz
	Ministry of Industry and New Technologies	**Website:** http://www.mint.gov.kz/
Related Electricity Association	Kazakhstan Electricity Association	**Email:** kea@nets.kz

[40] World Energy International 2009/2010
[41] Kazakhstan Wind Power Market Development Initiative

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9. Korea

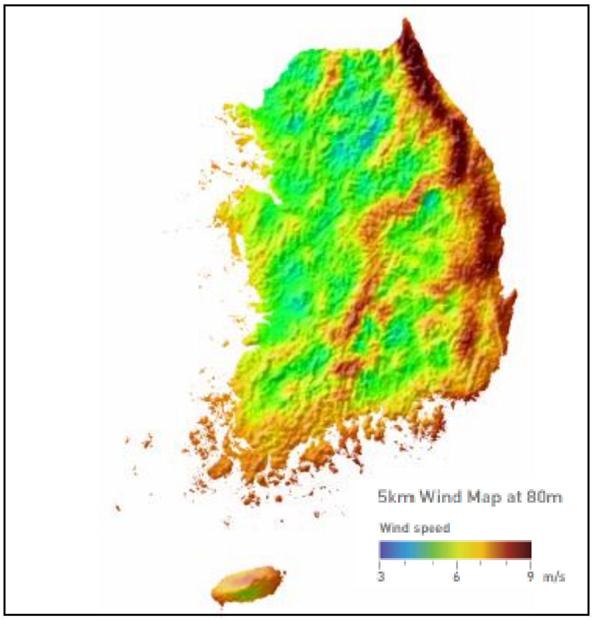

Figure 9: Korea Wind Resource Map at 80m

Opportunities:
• **Offshore wind development** has a high potential in the south-east of the country. • Low FIT was recently replaced with Renewable Portfolio Standard (applicable from 2012), with attractive price for Renewable Energy Certificates. • Large local manufacturing companies have entered the wind turbine onshore and offshore market • Strong policy and regulatory support from the government under its “Green Growth” strategy , which will see nearly 10.2 trillion won invested in a three-phase, 2.5GWoff-shore project off its southwestern coast carried out by a consortium of South Korean companies lead by Korea Electric between 2012 and 2019.
Challenges:
• Wind industry has lagged because of low FIT and public opposition. • RPS targets set by Government are aggressive. Assuming 70% of renewable energy is from wind, 2,390 MW should be built in 2012.The Korean Wind Energy Association estimates installation of 13.5GW of wind power by 2025. • Efforts are ongoing to ease the permitting process and to provide wind energy easier access to the power grid.

Table 9.1 Demographic and Basic Energy Data	
Population	48.9 million
Area	100,033sq km
Total electrical energy installed capacity	80 GW (2010)[42]
Electrification rate	100%[43]
Major Sources of Electricity	Hydro, Coal, Oil

Table 9.2 Wind Energy Data	
Total realizable wind energy potential	31-60GW(Based on various technical and geographical assessments)
Areas with good wind resource	Regions with class III to class V winds are Jeju Island, the Eastern coast of Kyeongbuk province, the Western coast of Jeonla province, and Daekwantyoung District (Korean Weather Forecast Bureau). Offshore wind good potential in Southeast of the country.
Total installed wind energy	407 MW[44] (December 2011)
Total wind energy projects in pipeline	10,000 MW
Renewable energy target	11% by 2030[45]
Wind energy target	23,000 MW by 2030[46] (optimal scenario) (10% of the total energy demand in the country)

Table 9.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	Replaced with RECs + System marginal price for electricity
Renewable Portfolio Standards	13 largest utilities are required to have renewable energy mix of 2% by 2012 and 10% by 2022
Renewable Energy Certificate (REC)	Wind farm operators will receive REC (one REC/MWh for onshore wind power produced, and two RECs for offshore wind farms). RECs have 20 years life span to help long-term investment and the current price of REC is Won 40/kWh (USD 0.36/kWh)[47].

Table 9.4: Wind Capacity by Year[48]

Year	Capacity (MW)
2000-2008	586
2009	236
2010	349

[42] http://www.eia.gov/cabs/South_Korea/Full.html
[43] REEEP
[44] Source: GWEC: Global Wind Statistics 2011.
[45] Global Wind Energy Outlook 2010 (GWEC)
[46] Global Wind Report 2010 (GWEC)
[47] USD 1.00 = W 1,108.05
[48] South Korea, http://www.gwec.net/index.php?id=177&L=0

Table 9.5 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
1. New and Renewable Energy Act: Provides for a new support scheme consisting of a feed-in tariff.	2002
2. Second Basic Plan for New and Renewable Energy Technology Development and Dissemination: To increase the country's share of renewable energy in total energy supply from 1.05% in 1999 to 5% in 2010.	2003
3. Renewable Portfolio Standard (RPS): The regulatory framework replaced FIT scheme, effective from 2012, which aims to compensate for the higher capital cost of renewable energy.	2010
4. The government has set a strategy for offshore wind power development to attract investments worth 10.2 trillion won (USD 8.2 billion) to develop offshore wind farms with a total capacity of 2.5GW. The government is trying to set up a public-private partnership (PPP) to install about 500 turbines off the west coast in the country.	
5. Local governments are also promoting offshore wind projects across the country.	

Table 9.6 Local Manufacturers
1. Samsung Heavy Industry: 2.5MW turbines for onshore and 6MW or bigger for offshore
2. Daewoo, Shipbuilding & Marine Engineering: 1.25MW and 2MW turbines and 6MW or larger
3. Hyundai Heavy Industry: 1.65MW, 2MW, and 2.5MW turbines for onshore and 5.5MW turbines for offshore use
4. STX: 2MW and 7MW turbines
5. Hyosung
6. Doosan Heavy Industry
7. Hanjin
8. Unison (750kW, 2MW, 3MW; Offshore 3.6MW)

Table 9.7 Useful Contacts:		
Government	Ministry of Knowledge Economy	**Contact Person:** Director General for Energy Resources Development, Office of Energy and Resources
		Website: http://www.mke.go.kr/language/eng/index.jsp
Wind Association	Korea Wind Energy Industry Association (KWEIA)	**Contact Person**: Rimtaig Lee, Chairman
		Website: www.kweia.or.kr
		Email: wind@kweia.or.kr
		Phone: +82 2 553 6426

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1. “Global Wind Energy Outlook 2010,” Global Wind Energy Council (GWEC), October 2010.
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3. “Policy & Regulatory Review 2010,” Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.
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10. Maldives

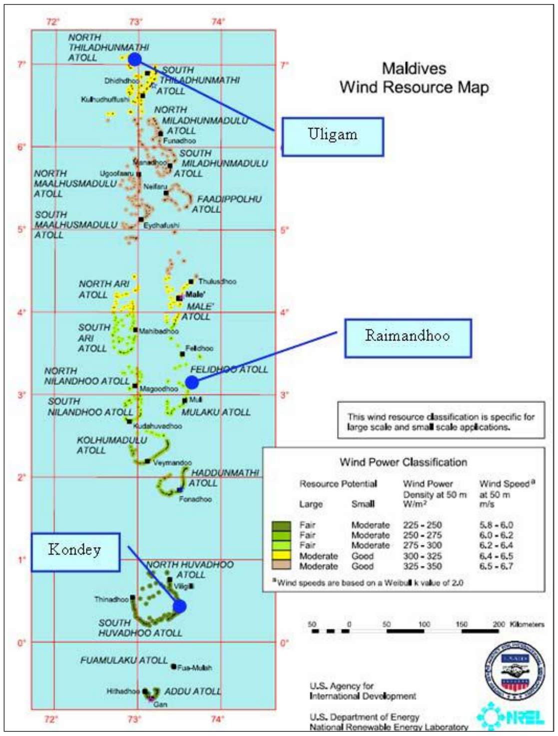

Figure 10: Wind Resource Map in Maldives

Opportunities:

- **Small-scale wind projects suitable for Maldives**. The dispersed nature of the islands makes it ideal for a distributed generation. Each inhabited island operates and maintains its own power generation and power distribution system.
- Majority of the islands have relatively low demand due to small populations. Most outer and remote islands' energy demand is under 500kW, providing good opportunity for **hybrid wind-diesel or wind-solar systems.**
- Closer islands' (small clusters of islands in the same atoll with shallow lagoons in between) grids can be potentially **connected** to provide several RE generating facilities pumping energy into the grid, increasing reliability through redundancy and better management of loads.

Challenges:

- **Wind resource data** need to be established in key areas. Currently available resource assessment indicates low average wind speed (6m/s or lower at 50m).
- **Capacity building** is needed at the institutional as well as the utility and island community level. Institutions need to be strengthened to plan and implement programs supporting renewable energy. Locals also need to be trained to manage and operate wind projects.

Table 10.1 Demographic and Basic Energy Data	
Population	0.32 million
Area	300sq km
Total electrical energy installed capacity	110 MW[49]
Electrification rate	100%[50]
Major Sources of Electricity	Oil

Table 10.2 Wind Energy Data	
Total realizable wind energy potential	288 MW[51]
Areas with ongoing wind resource assessment	Addu Atoll with 70m met towers by Suzlon Energy Ltd.
Areas with good wind resource	Northern Region
Total installed wind energy	95kW (all pilot projects)
Renewable energy target	Carbon neutral by 2020

Table 10.3 Fiscal and Regulatory Incentives	
Feed-in-Tariff for all RE technology	USD 0.23/kWh (MVR 3.50/ kWh)
Renewable Portfolio Standards	To be released based on the findings of the Renewable Energy Investment Plan
Others	Duty exemption on RE/EE equipment

Table 10.4 List of Wind Projects

Name/Location	Capacity (MW)	Year Operational	Project Cost (USD Million)	Funding Source
TosupplyMale; locationto be finalized	50MW of wind with 30MW of LNG backup system	Contract signed for 25 years	To be determined	Maldives' State Electric Company Limited (STELCO) with XMEC New Energy, China

Table 10.5 Relevant Policies

Relevant Policy Supporting Wind Power	Year
1. National Green Energy Policy	
2. Fund for Renewable Energy Systems Applications (FRESA): the first financial mechanism to support renewable energy technology in partnership with the Bank of Maldives	2008
3. The government of Maldives announced that Maldives will be the first carbon neutral country in the world within the next decade (Carbon Neutral Policy) by 2020	2009
4. Feed-In Tariff Policy	2011
5. Duty exemption for RE and EE related equipment	2011

[49]For inhabited islands only. Resorts have their own supply, amounting to about 120 MW additional electrical capacity. Energy Supply and Demand Report 2009.
[50] Asian Development Bank
[51]NREL, 2003.

Table 10.6 Procedure for Wind Farm Construction		
Procedure	**Agency Involved**	**Notes**
Tendering	Utility companies	Open bidding. So far mainly to design and build projects with PPAs. Specifications are determined by the utility company.

Table 10.7 Useful Contacts:		
Government	Ministry of Housing and Environment	**Contact Person:** Mr. Ahmed Ali, Assistant Director
		Website: www.mhe.gov.mv
		Email: ahmed.ali@mhe.gov.mv
		Phone: (+960) 3004 300

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3. "UNDP Welcomes Statement of the Government to Make the Maldives the World's First Carbon Neutral Country Within the Next Ten Years," United Nations Maldives, http://www.undp.org.mv/v2/?lid=99&dcid=44, 2008
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11. Mongolia

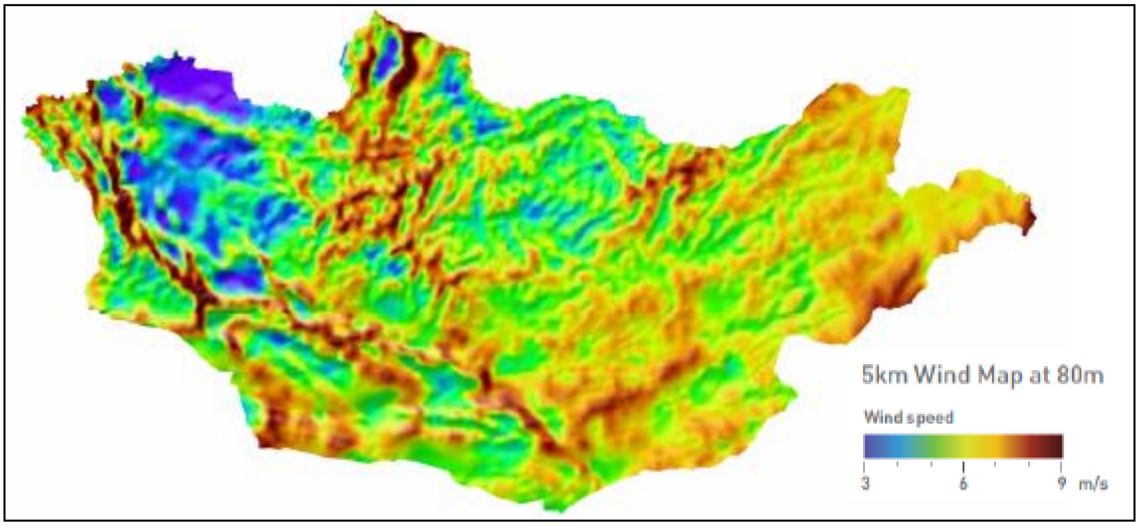

Figure 11: Mongolia Wind Resource Map at 80m

Opportunities:
• **Huge wind resource.** Good to excellent wind resource is available countrywide. South Gobi region is north of China's prominent wind corridor in Inner Mongolia, which has the largest concentration of wind farms. • **Electricity demand expected to increase rapidly.** Rapid expansion of mining in the south and rapidly improving standard of living will result in significant increase in demand for electricity. • **Wind power can be exported to China**. Mongolia's proximity to China opens up the possibility of exporting the excess wind power to its neighboring country.
Challenge:
• **Grid integration of wind power**. Variability of wind energy is difficult to accommodate in the current grid due to: (i) 91% of electricity generation is from coal-based CHP plants; (ii) peak load and reserve power is supplied by link from Russia; (iii) diesel or gas based spinning reserve generation is expensive because fuel is expensive (there are no local fuel reserves).Development of **hydropower in tandem with wind power** is a possible solution. • There is a need to develop the capacity of utilities in formulating **power purchase agreements** for wind projects and enhance **private sector participation** in a traditionally state-run sector.

Table 11.1 Demographic and Basic Energy Data	
Population	2.78 million
Area	1,564,116 sq km
Total electrical energy installed capacity	861.5 MW[52]
Electrification rate	80.0 %
Major Sources of Electricity	Coal and Oil

Table 11.2 Wind Energy Data	
Total realizable wind energy potential	1,100,000 MW[53]
Areas with ongoing wind resource assessment	240,000 hectares
Areas with good wind resource	South Gobi Region
Total installed wind energy	1.4 MW
Renewable energy target	24-26% by 2020
Wind energy target	110 MW by 2015

Table 11.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	USD 0.08 to 0.095/kWh
Renewable Portfolio Standards	MNS IEC-61400/2009

Table 11.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Project Cost (USD Million)	Funding Source
1. Erdenetsagaan	0.1	2004	0.15	State budget
2. Mandakh, Sevrei, Bogd, Khatanbulag, Tseel, Manlai	0.7	2007	3.70	State budget
3. Bayantsagaan, Bayan-Undur, Shinejinst, Matad	0.6	2008	2.50	State budget
4. SalkhitWind Farm	50.0	2012	85.00	Clean Energy LLC, Newcom Group
5. Choir Wind Farm	50.4			
6. Sainshand Wind Farm	52.0	2013	80.00	Sainshand
7. Khanbogd Wind Farm	100.0	2014	160.00	Qleantech LLC
8. Tsetsii Wind Farm	200.0	2015	302.00	Clean Energy LLC, Newcom Group

52 Wind Energy International 2009/2010

53 The National Renewable Energy Laboratory (NREL) in the US developed a wind energy atlas of Mongolia in 2001. Following wind measurements were conducted by: Newcom LLC at the level of 50m (2003, 2010); Qleantech at the level of 50m (2009); and the National Renewable Energy Center at the level of 50m (2010).

53 Total of the following: 50 MW Salkhit Wind Farm for 2012 commissioning; 52MW Sainshand, 100 MW Qleantech, and 200 MW Clean Energy at Tsetsii, all three at planning stages.

Table 11.5 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
1. Mongolia Integrated Power System (MIPS) worked towards creating a unified power grid connecting Central Energy System (CES) of Mongolia that connects Western and Eastern system to improve reliability and cost effectiveness.	2002
2. Mongolia Sustainable Energy Sector Development Plan has the following three goals: poverty reduction, development of a bigger private sector, and increased public participation.	2002-2010
3. National Renewable Energy Program decided on a renewable energy target by 2020.	2005
4. Mongolian Renewable Energy Law provided a tariff and Power Purchasing Agreement (PPA). Base rate for wind energy is USD 0.08 – 0.095/kWh and subsidy is USD 0.0 – 0.015/kWh in the first 10 years.	2007

Table 11.6 Procedure for Wind Farm Construction	
Procedure	**Agency Involved**
1. Lease land to conduct wind measurement	Local Government
2. Secure license to construct wind farm	Energy Regulatory Agency

Table 11.7 Useful Contacts:		
Government	Ministry of Mineral Resources and Energy	**Contact Person:** Mr. Ganbold Togooch, Officer for Renewable Energy
		Website: www.mmre.energy.mn
		Email: info@mmre.energy.mn
		Phone: 976- 99163103
Wind Developers	Newcom LLC	**Contact Person:** Mr. D. Gankhuyag
		Website: www.newcom.mn
		Email: gankhuyagd@newcom.mn
		Phone: 976 -99117630
	Qleantech LLC	**Contact Person:** Mr. D. Oyunbat
		Website: www.qleantech.net
		Phone: 976 -99110134

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3. “Mongolia,” Presentation by Bayanjargal Byambasaikhan to QLW2 Conference at Asian Development Bank, Manila, June 20-21, 2011.
4. Draft Mongolia Wind Energy Roadmap, prepared by Dr. Pramod Jain for the Asian Development Bank, 2011.
5. “Wind Energy International 2009/2010,” World Wind Energy Association, 2009.
6. International Energy Agency website:http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=MN
7. Inputs from Mr. D. Gankhuyag, Newcom LLC.

12. Pakistan

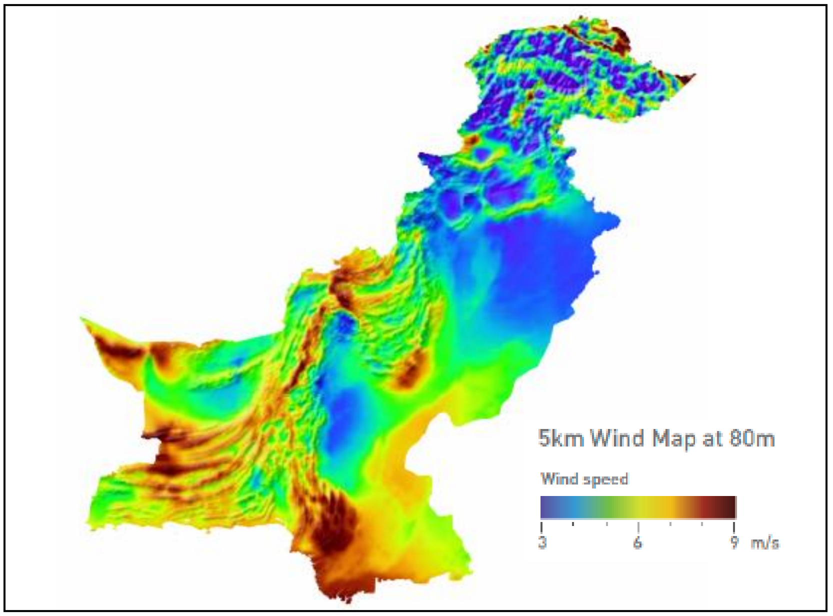

Figure 12: Pakistan Wind Resource Map at 80m

Opportunities:

- **Very good wind potential** in Southern and western part of Pakistan, specifically in Gharo-Keti, Bandar, and Jhampir wind corridors.
- **Attractive renewable energy incentives** are provided by the Government through its Renewable Energy Policy and Mid-term Policy. Government bears the wind and grid availability/connection risk.
- Tariff is attractive (**cost plus with up to 17% ROE**)
- **AEDB is a one-stop shop** to facilitate the development of wind power projects from land acquisition to actual implementation.

Challenges:

- Cumbersome cost-plus tariff determination process by the National Electric Power Regulatory Authority (NEPRA). It requires firm turbine, EPC contracts, and lenders' term sheet prior to submissions.
- Security issues limit the available land for wind farm development.

Table 12.1 Demographic and Basic Energy Data	
Population	166.5 million
Area	796,096 sq km
Total electrical energy installed capacity	19,420 MW
Electrification rate	62.4 %
Major Sources of Electricity	Oil, Gas, Hydro, Nuclear

Table 12.2 Wind Energy Data	
Total realizable wind energy potential	70,000 – 80,000 MW[54]
Areas with ongoing wind resource assessment	Gharo and Jhampir
Areas with good wind resource	50,000 MW estimated in Gharo-Keti Bandar and Jhampir Corridors with wind speed more than 7m/s at 60m height; Balochistan, Punjab and Northern Areas sites are being identified, estimated to harness 20,000 to 30,000 MW of wind power.[55]
Total installed wind energy	6 MW
Total wind energy projects in pipeline	556MW
Renewable energy target	9520 MW by 2030 (at least 5% share)

Table 12.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	USD 0.1187/kWh (Dawood power Ltd.), USD 0.1210/kWh (ZorluEnerji Pakistan Ltd.), USD 0.1192/kWh (Arabian Sea Wind Energy Pvt. Ltd.), and USD 0.1611/kWh (FFC Energy limited). ROE is 17-18%.
Other incentives from the Policy for Development of Renewable Energy for Power Generation	• Guaranteed electricity purchase • Grid provision is the responsibility of the purchaser • Counter guarantee by multilaterals for first few projects • Special incentives by the state bank for up to 10 MW plants • Net metering • Zero sales tax • Banking of electricity • Wheeling provisions • Grid spill over concept introduced • Carbon credits

[54] Source: Alternative Energy Development Board (AEDB) in collaboration with USAID and NREL.

[55] Aside from the AEDB wind resource assessment, the Pakistan Meteorological Department has conducted a detailed Wind Power Potential Survey of coastal areas of Pakistan, which enabled the identification of potential areas where economically feasible wind farms could be established.

Table 12.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Project Cost (USD Million)	FIT (USD/ kWh)	Status
1. ZorluEnerji Wind Power Project Phase 1 (Jhampir, Thatta); Total 50 MW capacity	6	121.99	0.1211	Year Operational: 2010
2. Dawood Power Ltd., Bhambore	50	120.34	0.1187	Acquired land, FS, generation license
3. Arabian Sea Wind Energy Pvt. Ltd., Lakha	50	142.23	0.1192	Acquired land, FS
4. FFC Energy Ltd., Jhampir	50	143.00	0.1611	Acquired land, FS, EPA (Under construction, expected operation: 2012)
5. Green Power (Pvt) Ltd, Kuttikun		108.80	0.1028	Acquired land, FS, generation license, EPA
6. TenagaGenerasi Ltd., Kuttikun	50			Acquired land, FS, generation license
7. Lucky Energy (Pvt) Ltd., Jhampir	50	132.35		Acquired land, FS
8. Metro Power Co. (Pvt), Jhampir	50			Acquired land
9. Gul Ahmed Energy Ltd, Jhampir	50			Acquired land
10. CWE, Jhampir	50			Acquired land
11. New Park Energy Ltd, Gharo			0.0950	Acquired land, FS, generation license
12. Master Wind Energy Ltd, Jhampir				Acquired land, FS
13. Zephyr Power Ltd., Bhambore				Acquired land, FS
14. Beacon Energy Ltd., Kuttikun		130.00	0.1250	Acquired land, FS, EPA
15. HOM Energy (Private) Ltd, Jhampir				Acquired land
16. Sachal Energy Development Pvt Ltd, Jhampir				Acquired land
17. Wind Eagle Ltd. (Technology Plc Ltd), Jhampir				Acquired land
18. Sapphire Wind Power Company (Pvt) Ltd, Jhampir				Acquired land, FS

Table 12.5 Relevant Policies

Relevant Policy Supporting Wind Power	Year
1. All imported plant, machinery and equipment for Renewable Energy Power Generation Projects had sales tax, income tax, and customs duty exempted.	2004
2. Policy for Development of Renewable Energy for Power Generation: Incentives for private sector including “Wind Risk Coverage”. Wind is considered as risk due to the variability of wind speed, thus the power purchaser such as the government absorbs the risk.	2006
3. Mid-term Policy: Builds on the previous RE Policy to make it more relevant to external changes. The new policy expanded the definition of alternatives and renewable, addressed concerns and resolved conflicts, incorporated lessons learned from local and international markets, expanded incentives and provided innovative financing such as the Alternative Energy Development Fund. Incentives under the new policy are: • Partial resource risk coverage • Tariff on the basis of a premium rate of return for RE projects • Mandatory grid connection • Mandatory purchase requirements • SBP Small renewable energy facility (<10MW) • Access to Alternative Energy Development Fund • ADB loan guarantee facility • Credit market facility • 100% carbon credits to IPP	2010

Table 12.6 Procedure for Wind Farm Construction

Procedure	Agency Involved
1. Secure letter of intent	AEDB
2. Acquire land	AEDB
3. Conduct feasibility study	-
4. Secure generation license	NEPRA
5. Determine tariff – on cost plus basis	NEPRA
6. Secure letter of support	-
7. Secure energy purchase agreement	NTDC
8. Secure implementation agreement	AEDB
9. Financial close	AEDB
10. Implementation/Execution	

Table 11.7 Useful Contacts:

Government	Alternative Energy Development Board, Ministry of Water and Power	**Contact Person:** Mr. Arif Alauddin, CEO
		Website: http://www.aedb.org/Main.htm
		Email:alauddin@aedb.org
		Phone: 051-9262947-48
Wind Association	Pakistan Wind Energy Association	**Contact Person:**

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13. Philippines

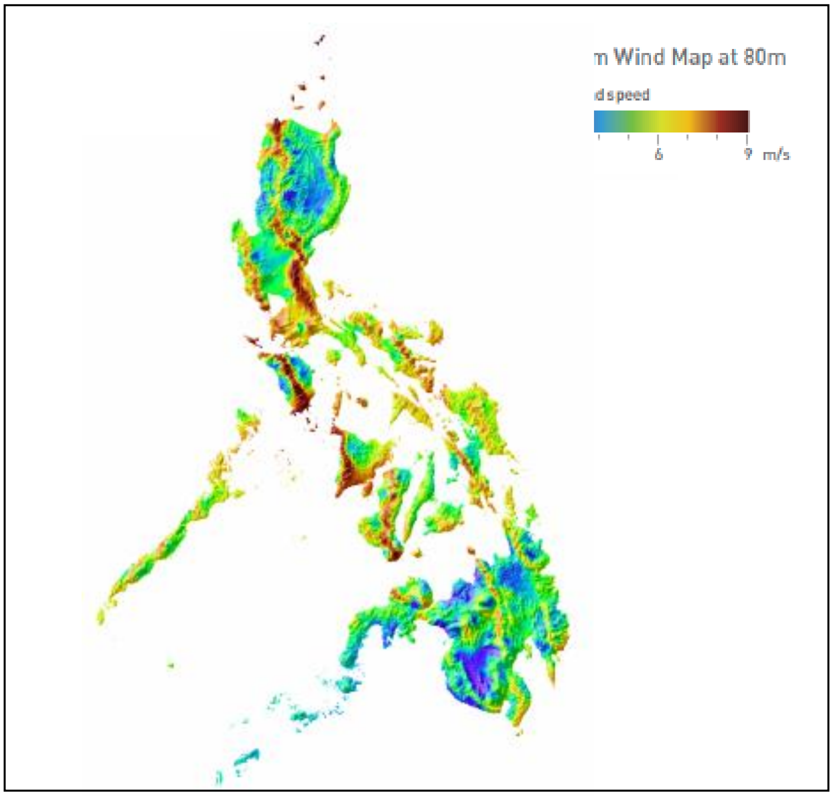

Figure 13: Philippines Wind Resource Map at 80m

Opportunities:
• **FiT Rates for wind have been approved.** The Philippine Energy Regulatory Commission approved in July 2012 a FiT rate for wind (P8.53/kWh or USD 0.197/kWh)[56], which is considered attractive enough to draw developers to build wind farms in the country. • **Wind rich corridors have been identified** with contracts already issued to some; all awaiting further development.56 wind service contracts with a potential total capacity of about **1,700 MW** have already been awarded.
Challenges:
• **High cost of electricity**. Public not receptive to additional increase in electricity rate (through a "Feed-in-Tariff Allowance or FIT-ALL") to add RE into the energy mix as existing cost of electricity is already high compared to other countries in the region. • Approval of the RPS and other enabling guidelines and mechanism (related to fiscal and non-fiscal incentives) are still pending.

[56] USD 1.00 =P43.31

Table 13.1 Demographic and Basic Energy Data	
Population	94 million
Area	300,000 sq km[57]
Total electrical energy installed capacity	16.36 GW
Electrification rate	99.8 %[58]
Major Sources of Electricity	Gas, Coal, Geo, Hydro, Oil

Table 13.2 Wind Energy Data	
Total realizable wind energy potential	7,400MW – 76,000MW[59]
Areas with ongoing wind resource assessment	Selected sites in North Luzon and Mindoro, mostly to establish feasibility of a specific wind project.
Areas with good wind resource	The north and north-east of the country has the best wind resource, and areas facing east towards the coast from Luzon to Samar also provide good-to-excellent wind resources for utility-scale projects, and excellent wind resources for small decentralized applications. Lower potential exists in the south and south-west of the archipelago. The estimated 7,400 MW potential covers 1,038 wind sites in the three islands: Luzon (686 sites, 4.9 GW), Visayas (305 sites, 2.17 GW), and Mindanao (47 sites, 0.37 GW).
Total installed wind energy	32.7 MW
Total wind energy projects in pipeline	220 MW
Wind energy target	425 MW by 2020 1,540 MW by 2030

Table 13.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	P8.53/kWh or USD 0.197/kWh. FiT for solar, run-of-river hydropower and biomass generated electricity have also been approved
Renewable Portfolio Standards	Market-based policy that requires electricity suppliers to source an agreed portion of their electricity supply from eligible renewable energy resources. The RPS rules are still pending.
Green Energy Option	A program that provides the end-users option to choose renewable energy resources. Guidelines for the Green Energy Option are still pending.
Net Metering for Renewable Energy	System in which a distribution grid user has a two-way connection to the grid and is only charged for his/her net electricity consumption, and is credited

[57] Wind Energy International 2009/2010
[58] Electrification Rate at Barangay Level, 16th EPIRA Implementation Status Report, Philippine Department of Energy, April 2010.
[59] Wind Energy International, 2009/2010. NREL estimates 76,000 MW without factoring in accessibility of sites.

	for any overall contribution to the electricity grid. The draft Net Metering Rules have been submitted by the National Renewable Energy Board to the Energy Regulatory Commission for review.
Others	**For Developers:** • 7 year Income Tax Holiday (ITH) • 10 year Duty-free Importation of RE Machinery • Equipment and Materials • 1.5% Special Realty Tax Rates on Equipment and Machinery • 7 year Net Operating Loss Carry-Over • 10 % Corporate Tax Rate after ITH • Accelerated Depreciation • Zero Percent Value-Added Tax Rate • Cash Incentive of Renewable Energy Developers for Missionary Electrification • Tax Exemption of Carbon Credits • 100% Tax Credit on Domestic Capital Equipment and Services, Exemption from the Universal Charge, Payment of Transmission Charge • Hybrid and Cogeneration Systems **For Suppliers, Fabricators, and Manufacturers:** • 7 year Income Tax Holiday (ITH) • 10 year Tax and Duty-free Importation of Components • Parts and Materials • Zero-rated value added tax transactions • 100% Tax Credit on Domestic Capital Components • Parts and Materials • Financial Assistance program

Table 13.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Developers
1. Bangui Wind Farm, Ilocos Norte	33	2005	Northwind Power Development Corporation, DANIDA
2. 16 MW Wind Farm, Puerto Galera, Oriental Mindoro	16	(For financial closing)	Philippine Hybrid Energy Systems, Inc.
3. Pasuquin– Burgos Wind Power Project, Ilocos Norte	120	(Development Phase)	Energy Logics Phils., Inc.
4. Tanay-Pililla Wind Power Project, Rizal	40	(Development Phase)	Alternergy Phil. Holdings Corp.
5. Lumban-Kalayaan Wind	40	(Development	Alternergy Phil. Holdings Corp.

Power Project, Laguna		Phase)	
6. Abra de Ilog Wind Power Project, Occidental Mindoro	40	(Development Phase)	Alternergy Phil. Holdings Corp.
7. Balaoi-Pagudpud Wind Power Project 1	40	(Development Phase)	Energy Development Corporation
8. Caparispisan-Pagudpud Wind Power Project	50	(Development Phase)	Northern Luzon UPC Asia Corporation
9. Balaoi-Pagudpud Wind Power Project 2	30	(Development Phase)	Northern Luzon UPC Asia Corporation

Table 13.5 Relevant Policies

Relevant Policy Supporting Wind Power	Year
Renewable Energy Law (Republic Act No. 9513): Promoting the development, utilization and commercialization of renewable energy resources. Fiscal incentives, non-fiscal incentives, and institutional support are provided.	2008
Institutional Support under the RE Law: a. Creation of National Renewable Energy Board b. Creation of the Renewable Energy Management Bureau c. RE Trust Fund –USD 8.5 billion to be invested in renewable energy in the next 10 years d. Financial Assistance Program e. The Philippines sets the milestones on the Wind Energy Road Map for 1.54 GW of wind capacity by 2030.	2009 2011

Table 13.6 Procedure for Wind Farm Construction

1. Apply for Renewable Energy Service Contract from Department of Energy
2. Lease or request land owner's consent to install monitoring device
3. Assess wind speed at location (Installation of wind meteorological masts at project site)
4. Conduct Feasibility Study

Table 13.7 Useful Contacts

Government	Department of Energy (DOE)	**Contact Person**: Jose Layug, Jr., Undersecretary
		Website: www.doe.gov.ph
		Email: jaylayug@doe.gov.ph
Wind Association	Wind Energy Developers Association of the Philippines (WEDAP)	**Contact Person:** Mr. Niels Jacobsen, President
		Email: nwind@mozcom.com

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4. “Policy & Regulatory Review 2010,” Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.

14. Sri Lanka

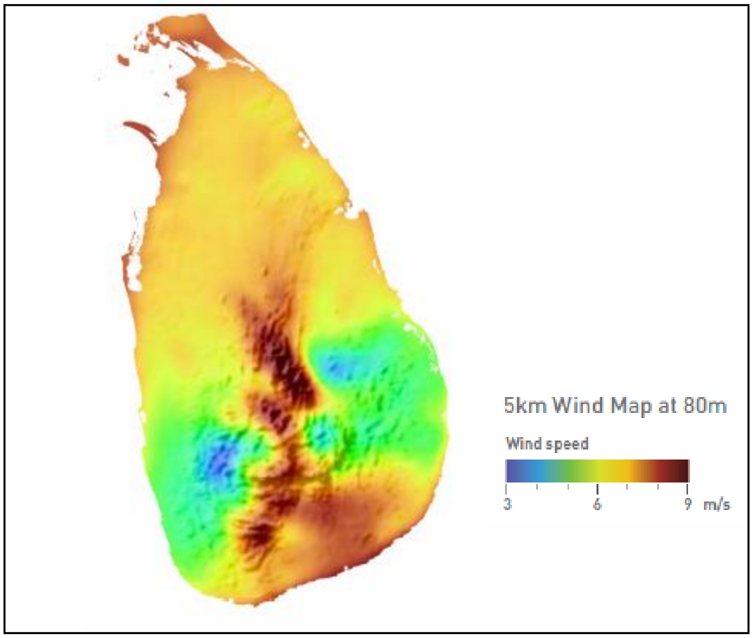


Figure 14: Sri Lanka Wind Resource Map at 80m

Opportunities:
• **Government offers high feed-in-tariff** at LKR 21.56(0.195 USD/kWh)[60] for wind power. • The country benefits from **consistent winds** over flat landscapes in the south-eastern and north-western coastal belt. But winds over mountainous regions are highly site specific.
Challenges:
• **Limited land available for wind farms**. Finding suitable land for development is becoming very difficult. Central highlands are inaccessible for wind development. • **Wind power competing with hydropower**. Operation of wind plants in high wind seasons (coinciding with the high hydro season) during off-peak hours restricts future development. At present, power purchase agreements feature a forced shut down period during off-peak periods. • There is lack of **transmission capacity** in high wind areas and grid stability when significant wind is injected into the grid.40 MW in recently installed wind capacity has been unable to connect to the grid, which has resulted in losses for the developer. • Government has decided to develop a 100 MW large-scale wind farm and have stopped issuing licenses to the private sector.

[60] USD 1.00 = LKR 110.55

Table 14.1 Demographic and Basic Energy Data	
Population	20.7 million
Area	65,610 sq km
Total electrical energy installed capacity	2,818MW[61]
Electrification rate	89.0 %
Major Sources of Electricity	Oil and Hydro

Table 14.2 Wind Energy Data	
Total realizable wind energy potential	20,740MW[62]
Areas with ongoing wind resource assessment	10 locations
Total installed wind energy	33 MW (December 2011)
Total wind energy projects in pipeline	64.1MW (June 2011)
Renewable energy target	10% by 2015 20% by 2020
Wind energy target	35 MW by 2012 250 MW by 2015[63]

Table 14.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	USD 0.195/kWh

Table 14.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Project Cost (USD Million)
1. Mampuri WPP (Puttalam Area)	10.00	2010	
2. Seguwantivu WPP (Puttalam Area)	10.00	2010	
3. Vidatamunal WPP (Puttalam Area)	10.00	2010	
4. Willpita WPP	0.24	2010	
5. Senok Wind Resources (Pvt) Ltd. (Mampuri III)	5.40	2012	
6. Senok Wind Energy (Pvt) Ltd (Mampuri II)	10.00	2012	
7. Ace Wind Power (Pvt) Ltd	3.00	2012	2.2
8. Nirmalapura Wind Power (Pvt) Ltd	10.00	2012	22.0
9. PowerGen Lanka (Pvt) Ltd	10.00	2012	22.0
10. PavanDanavi (Pvt) Ltd	9.80	2012	26.0
11. NalaDhanavi (Pvt) Ltd	4.80	2012	13.0
12. Ambewala Wind Power (Pvt) Ltd	1.10	2012	1.4
13. DLR Energy (Pvt) Ltd	10.00	2012	17.3

[61] USAID/SARI Energy
[62] NREL
[63] CEB assured Ministry of capacity to absorb 250 MW of wind by 2015 coming from Puttalam (90 MW), and other areas.

14. Mannar Wind Farm	100.00	2015	

Table 14.5 Relevant Policies	
Relevant Policy and Provisions Supporting Wind Power	**Year**
National Energy Policy and Strategies provides for the increase in share of non-conventional renewable energy aside from hydropower by 10%.	2008

Table 14.6 Local Capacity	
Name of Company	**Type**
Senok Wind Power	Local private construction company; constructed the first wind plant
Sri Lanka Wind Power	Local wind project development company

Table 14.7 Procedure for Wind Farm Construction
1. Obtain Energy Permit from Sustainable Energy Authority
2. Obtain Generation License from Public Utility Commission Sri Lanka
3. Secure standard Power Purchase Agreement from Ceylon Electricity Board

Table 14.8 Useful Contacts:		
Government	Ceylon Electricity Board	**Website:** www.ceb.lk/EPT/NCRE
	Sustainable Energy Authority of Sri Lanka	**Contact Person:** Dr. Thusitha Sugathapala
		Website: http://www.energy.gov.lk
Wind Association	Wind Power Association of Sri Lanka	**Contact Person:** Mr. Noel Selvanayagam, President
		Email:

References

1. Case Study: "Seguwantivu & Vidathamuni Wind Power Project" by Manjula Perera at QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012
2. "Sri Lanka Wind Development Status", presentation by Noel Priyantha at QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012
3. "Sri Lanka," Presentation by Thusitha Sugathapaia to QLW2 Conference at Asian Development Bank, Manila, June 20-21, 2011.
4. "Wind Power in Sri Lanka," Wind Power.lk, http://www.windpower.lk/index.html
5. "Policy & Regulatory Review 2010," Renewable Energy & Energy Efficiency Partnership (REEEP), 2010.

15. Thailand

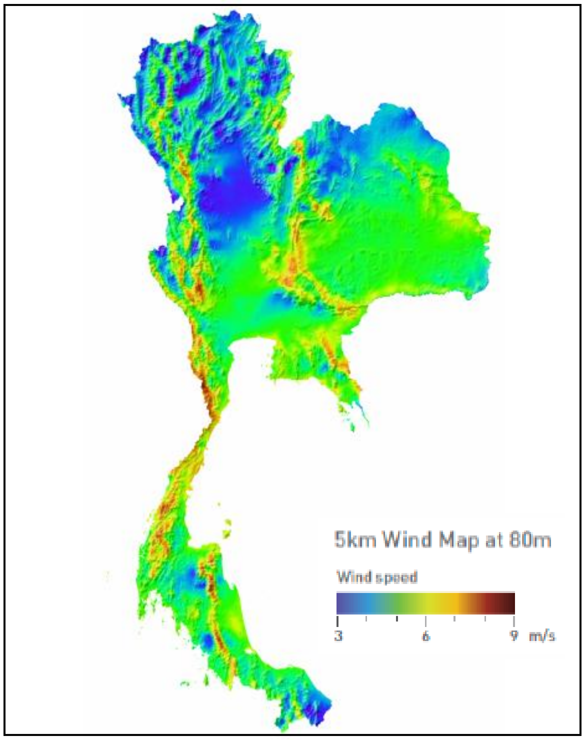


Figure 15: Thailand Wind Resource Map at 80m

Opportunities:

- **Strong government support.** The Renewable Energy Development Plan (REDP) is backed by supporting measures to promote renewable energy.
- **Consistent energy policy**, focusing on encouraging private sector participation, provides a stable investment climate.
- **Low-risk PPA** through additional incentives is provided to small power producers (SPP) and very small power producers (VSPP).
- Thailand has a **mature project finance market** for wind projects

Challenges:

- **Low wind speed** in most areas of the country. Best wind speeds in certain areas are between 6-7 m/sat 90 meter elevation.
- Wind rich areas are in protected national parks and rugged mountainous areas.
- Policy on land use especially on agriculturally designated land

Table 15.1 Demographic and Basic Energy Data	
Population	67.31 million
Area	513,115 sq km
Total electrical energy installed capacity	31,500MW
Electrification rate	98.5 %
Major Sources of Electricity	Natural Gas, Coal, Hydro, Biomass, Oil

Table 15.2 Wind Energy Data	
Total realizable wind energy potential	190,000MW
Areas with ongoing wind resource assessment	Wind resource measurements are taken in 45 wind stations at 40m height, and 23wind stations at 90m height. Micro scale wind mapping 200 x 200 meter ongoing in 15 zones
Total installed wind energy	7.3 MW (December 2011)
Total wind energy projects in pipeline	645MW
Renewable energy target	25 % by 2021
Wind energy target	1200MW by 2021

Table 15.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	Feed-in Premium (“Adder”) on top of regular tariff for wind power. Adder-VSPP is USD 0.15/kWh (installed capacity <= 50kW) and USD 0.12/kWh (installed capacity > 50kW) for 10 years. Base rate is USD 0.09/kWh.
Others	• BOI Tax incentives scheme (duty free for imported machinery, 8-yearcorporate income tax holiday, and others) • Technical assistance such as wind energy potential database available to the public • Soft Loans for RE+EE investments from the Energy Conservation Fund (ENCON Fund) made available through commercial banks • Government Co-investing scheme (“ESCO Fund”) to share risk with private developer

Table 15.4 List of Wind Projects (Installed and Pipelined)64

Name/Location	Capacity (MW)	Year Operational	Funding Source
1. Lhaem Prom Tep in Phuket	0.02	1992	Electricity Generating Authority of Thailand (EGAT)
2. Lhaem Prom Tep in Phuket	0.15	1996	Electricity Generating Authority of Thailand (EGAT)
3. Bann Ta Le Bung, Hua Sai District in Nakhon	0.25 + 1.5	2007 and 2009	DEDE

[64]Source: Ruangdet Panduang, Director, Wind Energy Group, Thailand.

Srithammarat			
4. LumTa Kong Dam in Nakhon Ratchasima	2.5	2009	EGAT
5. Tao Island in Chumphon	0.25	2010	PEA
6. Chathing Phra District in Songkhla Province	1.5	2011	PEA
7. Pattani Province	0.25 + 1.5	2012 (status: unknown)	DEDE
8. KAO-KOR wind farm, Pechchaboon Province	60	2012 (status unknown)	Ratchaburi Electricity Generating Holding Public Company Limited, Aeolus Power Co., Ltd , and Chubu Electric Power Korat, BV
9. HUAI-BONG II wind farm, Nakhon Ratchasima Province	103.5	2012 (under construction)	KR2 Co., Ltd. Equity: Ratchaburi Electricity Generating Holding Public Company Limited, Aeolus Power Co., Ltd , and Chubu Electric Power Korat, BV. Debt: Kasikorn Bank PLC and Siam Commerical Bank PLC
10. HUAI-BONG III wind farm, Nakhon Ratchasima Province	103.5	2013	First Korat Wind Co., Ltd. Equity: Ratchaburi Electricity Generating Holding Public Company Limited, Aeolus Power Co., Ltd , and Chubu Electric Power Korat, BV. Debt: Kasikorn Bank PLC and Siam Commerical Bank PLC
11. Chaiyaphum Wind Farm	90	2014	EGCO
12. Subyai Wind Farm	100	2014	EGCO
13. Thaprarak Wind Farm, Nakhon Ratchasima Province	92	2016	-
14. Tropical Wind Farm, Nakhon Ratchasima and Chaiyaphum Province	92	2016	-
15. KRS3 Wind Farm, Nakhon Ratchasima and Chaiyaphum Province	92	2016	-
16. Thepsathit Wind Power,	90	-	ADB

Chaiyaphum			
17. Theppana Wind Power, Chaiyaphum	15	-	ADB
18. VSPP	72.018	2012-2015	Private Sector

Table 14.5 Relevant Policies

Relevant Policy Supporting Wind Power	Year
Alternative Energy Development Plan (AEDP 2012-2021) provides Government funding on research and development activities, encouraging private-led investment	2012
Revised Power Development Plan	2010

Table 15.6 Procedure for Wind Farm Construction& Useful Contacts64

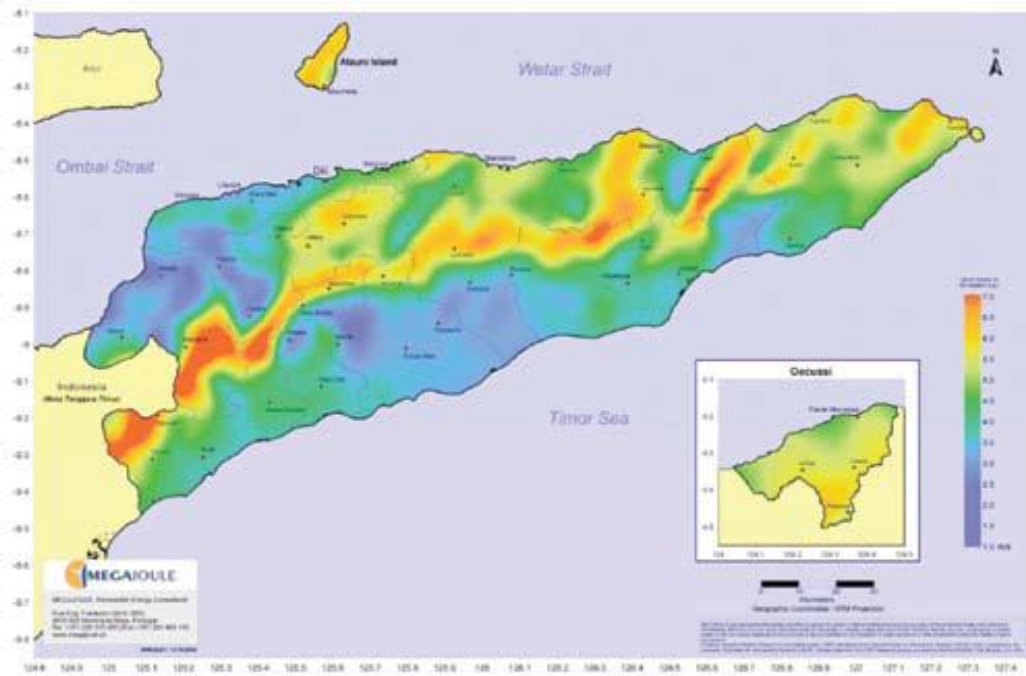
1. Government-owned land, secure permits and licenses from Government agency.	Agricultural Land Reform Office	-
	Royal Forest Department	-
	Department of Social Development and Welfare	-
	The Ministry of Defense	-
	Local Government	-
2. License for Power Generation	Energy Regulatory Commission	**Contact Person:** Mr.Pornchai Pratiphanpreechawut, Deputy Secretary General
		Tel. +6622073599 Ext 529
		Email: pornchai@erc.or.th
3. Power Purchase Agreement	Department of Alternative Energy Development and Efficiency	**Contact Person:** Dr. Sutubutr Twarath, Deputy Director-General
		Email: twarath@dede.go.th
		Contact Person: Mr.Graiwan Khutgul, Director of Wind Energy Group, Bureau of Energy Research
		Email: graiwan_k@dede.go.th
		Website: http://www.dede.go.th/dede/
	Energy Policy and Planning Office	**Contact Person:** Mr.Samerjai Suksumek
		Tel. +662612 1555

	Electricity Generation Authority of Thailand	**Contact Person:** Mr. Nattawat Jirawatcharakunaruk
		Email: udom.k@egat.co.th
	Provincial Electricity Authority	**Contact Person:** Mr. Prasan Meepramul
		Email: prasan@pea.co.th

References

1. Case Study: “Huaybong Wind farm”, presentation by Philip Napier-Moore to QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012
2. “Update on Wind Energy Developments in Thailand”, presentation by Twarath Sutabutr, Sc.D to QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012
3. “Thailand’s Wind Energy Status,” Presentation by Engr. Ruangdet Panduang to QLW2 Conference at Asian Development Bank, Manila, June 20-21, 2011.
4. “Wind Energy International 2009/2010,” World Wind Energy Association, 2009.
5. DEDE Wind Power Generation for 60 Communities
6. Thailand Renewable Energy Policies and Wind Development Potentials, Department of Alternative Energy Development and Efficiency, Bangkok, 2010.

16. Timor-Leste



Source: Electrification Plan of Timor-Leste based on Renewable Energy, 2010

Figure 16: Wind Resource Map of Timor-Leste

Opportunities:
• Power projects are candidates for development under the **public-private-partnership** policy that is being prepared by the government • The government has targeted half of all energy needs to be met by renewable energy sources by 2020
Challenges:
• The power system infrastructure is in poor condition, suffering from **high technical losses** and needs urgent equipment replacement • **Commercial losses** of the government power utility Electricidade de Timor-Leste (EdTL) is very high with only around 40% of commercial customers in Dili paying their electricity bills

Table 16.1 Demographic and Basic Energy Data	
Population	1.066 million
Area	15,000 sq. km.
Total electrical energy installed capacity	50 MW
Electrification rate	37%[65]
Major Sources of Electricity	Diesel generating sets

Table 16.2 Wind Energy Data	
Total realizable wind energy potential	72 MW
Areas with good wind resource	The mountainous areas east of Maliana, and southwest and east of Venilale and Quelicai. Further testing at five weather stations over a 12 month period and the results of technical computer analysis have revealed Bobonaro and Lariguto as having conditions best suited to wind power. Other potential wind sites are Fatumean (Cova Lima) Aituto (Ainaro) and Lebos (Bobonaro).
Total installed wind energy	-
Total wind energy projects in pipeline	The Lariguto wind farm will be constructed as a model wind farm development
Renewable energy target	Half of all energy needs to be met by renewable energy sources by 2020
Wind energy target	-

Table 16.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	Still to be determined

Table 16.4 List of Wind Projects (Installed and Pipelined)

Name/Location	Capacity (MW)	Year Operational	Project Cost (USD Million)	Funding Source
1. Baucau	8.5			
2. Bobonaro 1	8.5			
3. Bobonaro 2	8.5			
4. Aileu	11.9			
5. Laleia	0.85			
6. Lariguto 1	11.05			
7. Lariguto 2	5.95			

[65] Sector Assessment (Summary): Energy, Country Partnership Strategy: Timor-Leste, 2010-2015, ADB

Table 15.5 Relevant Policies	
Relevant Policy Supporting Wind Power	**Year**
1. Timor-Leste Strategic Development Plan 2011 – 2030	2011

Table 15.6 Useful Contacts:		
Government	Secretary of State for Energy Policy	**Contact Person:** Lino M. N. C. Correia
		Website:
		Email: bemori007@yahoo.com

References

1. "Timor-Leste Wind Development Status", presented by Lino M. N. C. Correia to QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012
2. Timor-Leste Strategic Development Plan 2011-2030
3. Sector Assessment (Summary): Energy, Country Partnership Strategy: Timor-Leste, 2010-2015, ADB

17. Vietnam

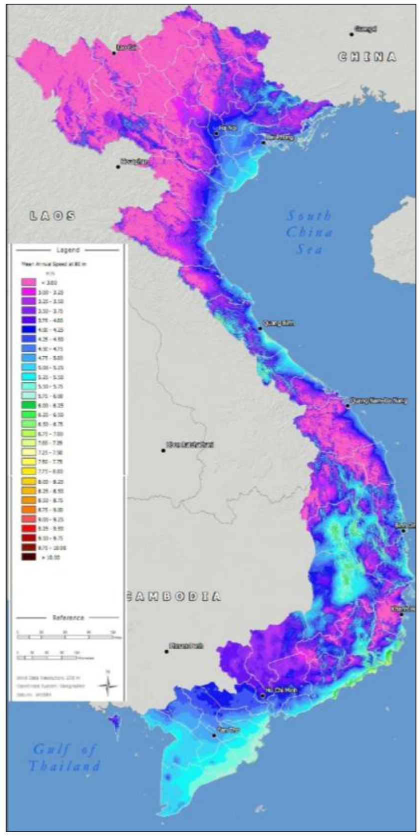


Figure 17: Wind Resource Map of Vietnam at 80 m height

Opportunities:
• **High wind potential** compared to neighbors in Southeast Asia.[66] • The government and people show a **steady support for renewable energy development**, particularly wind energy to satisfy rapidly increasing electricity demand. • **Regulatory framework for renewable energy** is being developed.
Challenges:
• **Feed-in-tariff lower than current production costs.** • **Land restrictions hinder wind farm construction.** Most of the wind-rich locations are along black sand areas which, by current regulations, should be utilized before wind farm construction starts. In Binh Thuan province, viable wind farm areas are also marked for titanium mining.

[66] United Press International Asia - Energy Resources Vietnam's high wind power potential, Article, July 2009

Table 17.1 Demographic and Basic Energy Data	
Population	86.48million
Area	332,000sq km
Total electrical energy installed capacity	21,297MW
Electrification rate	97 %
Major Sources of Electricity	Gas, Hydro, Coal, Oil

Table 17.2 Wind Energy Data	
Total realizable wind energy potential	642,000MW
Areas with good wind resource	Average wind speed in good areas is 6m/s at 60m height. The potential is comparatively higher in the central region at approximately 880 MW and southern region at approximately 855 MW particularly in the highlands, islands, and coastal areas. The potential in the northern region is about 50MW.
Total installed wind energy	30 MW[67] (December 2011)
Total wind energy projects in pipeline	37 projects in pipeline (4,296 MW)
Renewable energy target	5% by 2020 (2,900MW)
Wind energy target	11% by 2050

Table 17.3 Fiscal and Regulatory Incentives	
Wind Feed-in-Tariff	The government approved a FIT = USD 0.078/kWh[68] for wind power **plus** subsidy of USD 0.01/kWh from the Environment Protection Fund

Table 17.4 List of Wind Projects (Installed and Pipelined)69

Name/Location	Capacity (MW)	Year Operational	Project Cost (USD Million)	Funding Source
1. Bach Long Vy Island	0.8	2005	0.002	
2. REVN-BIT Wind Power Project, Commune Binh Thach – Tuy Phong – Binh Thuan	30.0	2011	80.000	REVN-BIT
3. Bac Lieu Wind farm, Bac Lieu province	120.0	2012 (status: 99MW under construction)	225.000	Cong Ly Construction-Trade-Tourism Ltd.
4. Phu Quy Wind farm, Phu Quy Island	6.0	2012 (status: unknown)	16.700	PV Power
5. Phuong Mai 3, Binh Dinh	21.0	2012	40.000	Central Region

67 Source: GWEC: Global Wind Statistics 2011.
68 USD 1.00 = VND 20,656.70
69 "Opportunities and Challenges to Scaling Up Wind Power in Vietnam," Presentation by Nguyen Anh Tuan to QLWP Conference at Asian Development Bank, Manila, June 21, 2010. "Wind power development status in 2011", Institute of Energy internal report December 2011.

	Province		(status: unknown)		Wind Power Company
6.	Cau Dat wind farm, Lam Dong province (Phase 1)	30.0	2012 (status: unknown)	57.000	Cavico Transport and Construction

Table 17.5 Relevant Policies		
	Relevant Policy Supporting Wind Power	**Year**
1.	Renewable Energy Action Plan was developed by Electricity of Vietnam (EVN) and the World Bank jointly. It set out a 10 year framework to be delivered in two 5-year phases of international assistance to scale up the development and use of renewable energy for rural electrification and grid supply.	1999
2.	Electricity Law was passed. It promotes exploitation and use of renewable energy sources for electricity generation. Provides incentives for investment, tax benefits in renewable energy projects and sets electricity tariffs. It particularly encouraged construction of decentralized grids and renewable energy power plants for local users in rural, mountainous and island areas.	2005
3.	Clean Development Mechanism (CDM) provided rights and obligations of contractors and implementers. Subsidy provided for CDM projects in prioritized areas.	2007
4.	National Power Development Master Plan (2006-2015) with outlook to 2025, highlighted development of renewable energy for remote, mountainous, islands, and border areas.	2007
5.	National Energy Development Strategies for Vietnam up to 2020 and outlook to 2050: The share of renewable energy was set at 3% of total primary energy supply by 2010, 5% by 2020, and 11% by 2050. It further enunciated that electrification rate should reach 100% by 2020.	2007
6.	Joint Circular: Regulation on price subsidy for products from CDM projects including wind power generation.	2008
7.	Regulations published with conditions and procedures for construction of renewable energy based small power plants connected to the national power grid.	2008
8.	Decision No 37/2011/QD-TTg of the Prime Minister on incentives mechanisms to support the development of wind power projects in Vietnam	2011

Table 17.6 Local Capacity		
	Name of Company	**Type**
1.	Institute of Energy	Wind resource mapping, appraisal, feasibility studies, and wind measurement
2.	Subsidiary company of EVN - the Power Engineering & Consulting Company (PEEC3)	Monitoring and analysis of wind resource data
3.	GE Energy Hai Phong	Wind turbine manufacturer

Table 17.7 Procedure for Wind Farm Construction	
Procedure	**Agency Involved**
1. **Selection**: Data screening; Site investigation; Registration with PPC; site approval license	Provincial People Committee (PPC)
2. **Wind assessment**: Installation of wind measurement equipment	
3. **Investment report**: Preparation of investment report; Requesting for amendment into power development plan; Approval for investment report	MOIT or Prime Minister
4. **Investment project report**: Preparation, appraisal and approval of investment project report; Basic design	DOIT or MOIT for basic design
5. **Power Purchase Agreement (PPA)**: Negotiation and signing PPA with EVN [For projects <30 MW, apply SPPA (Standard PPA)]	Electricity of Vietnam (EVN)
6. **Implementation**: Detailed technical and construction design; Total investment report; EPC	

Table 17.8 Useful Contacts:		
Government	General Department of Energy, Ministry of Industry and Trade (MOIT)	**Contact Person:** Mr. Pham Manh Thang
		Website: www.moit.gov.vn
		Email: thangpm@moit.gov.vn
		Phone: +84-4-2220 2433
Wind Association	Binh Thuan Province Wind Power Association	**Contact Person:** Mr. Nguyen Boi Khue, Chairman

References

1. "Vietnam Wind Development Status", presentation by Pham Thuy Dzungto QLW3 Workshop at Asian Development Bank, Manila, June 4-5, 2012
2. "Opportunities and Challenges to Scaling Up Wind Power in Vietnam," Presentation by Nguyen Anh Tuan to QLWP Conference at Asian Development Bank, Manila, June 21, 2010.
3. "Policies on Promoting Low Carbon Energy Supply in Vietnam," Presentation by Nguyen Anh Tuan to Asia Pacific Energy Research Centre (APERC) Annual Conference 2011, Tokyo, March 7 & 8, 2011.
4. "Wind Energy International 2009/2010," World Wind Energy Association, 2009.

Summary

This compendium of wind energy data was undertaken by ADB to help facilitate the development of wind energy projects in the Asia Pacific region. The report provides a source of technical and country specific information to prospective wind developers, investors and manufacturers to facilitate the development of future wind projects. The initiatives and implementation philosophies highlighted in this report may also serve as guideposts to power utilities, policy makers and regulators in the crafting of their own wind energy strategies.

Wind is a high potential alternative energy source for Asia and the Pacific. The current trend indicates higher growth of wind power installations in Asia compared to both North America and Europe. Despite the high rate of growth in the past few years, only 2% of the estimated 5,300 GW potential has been harnessed to date. The largest fraction of installations in Asia is in China and India, but the rest of Asia is poised for high growth as new policies and incentives emerge to support wind energy development. This report highlights that to accelerate wind development, many countries need to resolve major issues including lack of accurate wind resource data, transparent feed-in-tariffs, and supporting infrastructure.

Table 18.1: Summary of Installed, Pipelined, and Target Wind Capacity by Country

	Country	Estimated Wind Potential (MW)	Installed Wind Capacity (MW)	Pipelined Wind Capacity (MW)	Target Wind Capacity (MW)	By Year	2020 Projected Investments from Wind ($ Million)
1	Afghanistan	158,000	0.400		-		
2	Bangladesh	20,000	1.9	100	1,200	2020	2,400.00
3	China, People's Rep. of	2,590,000	62,733.0	18,339.00	150,000	2020	300,000.00
4	Fiji Islands	-	10	0.5	-		1.00
5	India	100,000	17,372.0	48,000.00	65,111	2020	130,222.00
6	Indonesia	9,300	0.5	-	255	2025	510.00
7	Japan	280,000	2,501.00	175	-		350.00
8	Kazakhstan	2,000	-	-	-		0.00
9	Korea, Republic of	45,000	407	10,000.00	23,000	2030	46,000.00
10	Maldives	288	-	-	-		0.00
11	Mongolia	1,100,000	1.4	400	110	2015	220.00
12	Pakistan	80,000	6	556	9520	2030	19,040.00
13	Philippines	55,000	33	220	425	2020	850.00
14	Sri Lanka	20,740	33	64.1	250	2015	500.00
15	Thailand	190,000	7.3	645	1200	2024	2,400.00
16	Timor-Leste	72	-	55.25	-		
17	Vietnam	642,000	30	4,296.00	-		354.00
	TOTAL	**5,292,400**	**83,137**	**82,851**	**251,071**		**502,957.50**

Notes:

a. An estimate of $2,000/kW was used to compute the projected investment cost.

b. For countries without 2020 target wind capacity, the pipelined total was used to estimate the projected total investments.

c. Some countries have set targets for 2015, 2022, 2025, and 2030. The 2020 projected investment cost is a very rough estimation of the expected capacity by 2020.

d. Installed wind capacity is as of Dec 2011. Asian country not on the list with significant wind installation is Taiwan with 564 MW. Total installed wind capacity is for all of Asia. Source, GWEC: Global Wind Statistics 2011.

The countries reviewed expect to install about 82 GW of wind power in the medium-term (5 to 10 years), equivalent to about 1.5% of the region's wind potential. In 10 to 20 years, the total operational wind power is projected to be 255 GW[70], four times that of the existing capacity. This estimate could double with appropriate support and incentives in countries with abundant wind energy potential like Mongolia, Kazakhstan, Pakistan, and Sri Lanka. To realize this potential, however, countries need to focus on the following key activities:

- Formulate and implement clear and transparent policies on land use, tariffs and incentives. Policies were identified as the most important drivers for wind and renewable energy investments. Countries cannot focus solely on hardware and technology. The entire system, both software and hardware must be smarter to increase the chance of success.

- Engage and involve the transmission and distribution utilities and regulators in the early stages of development. Grid integration is a universal concern for large and small-scale wind energy development and is a fundamental ingredient to success.

- The Feed-In-Tariff (FIT) must not be treated as a static number. It is something that needs to be monitored, changed, and evolved. FIT should indeed fit the local political, cultural and economic situation of the country.

[70] Total includes installed and pipelined capacity in countries that were not able to provide a 2020 target.

Appendix I: Case Studies[71]

This appendix presents two case studies from India and Sri Lanka that provide insights into the various methodologies being adopted in the South Asian region for appraising and developing wind power projects.

I.1 India: Wind Farm for Captive Use

Name of the Owner: Oil and Natural Gas Corporation Ltd.
Off Taker: Oil and Natural Gas Corporation Ltd.
Size, Location: 51 MW, Jakhau Site, District Kutch, Gujarat

Project Description

ONGC Ltd. floated a tender for the development of a wind power project in Gujarat on a turnkey basis. After the technical and financial due diligence were completed, the project was awarded to Suzlon Energy Ltd. This 51 MW project has 34 wind turbines with a capacity of 1.5 MW each. The project development activities included site identification, turbine supply, site development, wind turbine erection, development of electrical lines and substation for the evacuation of power, obtaining necessary permissions and approvals, and commissioning of the project. The project was commissioned in September 2008 and has been in operation since then.

Equipment Package

The equipment package included nacelle assembly, tower, hub, blade set, power panel, DP VCB yard, electrical lines, and 34 WTGs of 1.5MW each.

Project Time Line

The project was completed over an eight-month period from the receipt of the order from ONGC Ltd.

[71] Source: Supporting Wind Power Take-off in the SARI/Energy Region, Draft Report, Prepared for USAID India, Prepared by Tetra Tech India, December 2010.

Wind Regime

The annual average wind power density at the Jakhau site where the project is located is 311 W/m^2 measured at the height of 50m from ground level.

Power Generation Estimation

Based on the wind regime at the site, turbine characteristics and the micro-siting of the turbines at the site, the annual power generation is estimated to be 2,928,000 kWh/turbine, with a capacity utilization factor of 27%.

Grid Interconnection

The 51MW wind farm is connected to the 220/33kV substation situated at the project site. This substation was developed as part of the wind project. The 220 kV NaniSindhodi substation is further connected, through a 220kV line, to the substation of Gujarat Electricity Transmission Company located at NaniKhakad, which is about 30km from the wind project location.

Costs

The total project cost for the 51MW wind project was about INR 3070 million. The power generated from the wind project is wheeled at different locations, 98 plants/offices of ONGC, and used as captive power. Four percent of the power generated from the project is deduced from the final unit adjustment, and put towards open-access charges (charges for using the grid infrastructure). The 4% deduction also includes wheeling and transmission losses. By using wind power at different locations, ONGC reduced its power purchases from the distribution utility at the industrial rate for power, which is about Rs6.00/kWh.

Incentives
The incentive mechanisms used by the projects are:

1. Concessional open access charges of 4%, whereas the normal charges are higher for transactions involving conventional power (e.g., the transmission charge alone is about INR 2,000/MW/day and 18% transmission losses).

2. There are special provisions for the banking of energy. In the case of wind power plants, energy generation cannot be scheduled, often resulting in excess generation in real time rather than demand in the case of captive use. However, the consumer gets credit for all energy produced and sold on a monthly basis (i.e., the excess generation during the month is "banked" in the grid).

I.2 Sri Lanka: Grid-Connected Wind Farm (Senok Group)

Names of Owners	M/s Segavantivu Wind Power (Pvt) Ltd & M/s Vidatamunai Wind Power (Pvt) Ltd Mr Manjula Perera, Chief Executive Officer
Off-taker	Ceylon Electricity Board
Size, Location	20 MW, Puttalam

Project Design and Basic Schematic
Gamesa conducted micro-siting for AE59-800 kW machines considering the wind pattern and land availability at the identified site. The wind farm was installed on flat terrain between 2 and 10 m above sea level.

Both electrical and civil works were undertaken by Gamesa.

Equipment Package
The equipment package included the nacelle, blade, tower, anchor, rotor hub, and electro-mechanical accessories for the tower and nacelle, as required by the customer.

Project Timeline
In order to complete the scope of work – which included supplying the equipment, erecting the project, commissioning, and supervising the civil foundation – the project's timeline was

originally envisioned to be six months. However, due to a few unforeseen events related to logistics, it was completed in about eight months.

Wind Regime

The wind regime that prevails at the Puttalam site is class IIIA as per the IEC classification. It is suitable for AE59-800 kW machines that were installed for this project.

Power Generation Estimates

The estimated gross annual power generation is 2.8 million kWh per WTG and the gross plant load factor is about 40%. The estimated net power generation from the wind farm is about 65 million kWh per year.

Grid Interconnection

A 33 kV grid is connected to the wind farm to evacuate the power generated and a 14.7 km transmission line has been constructed to the nearby substation in Kallady.

Tariff and Costs

The project developer has signed a PPA with Ceylon Electricity Board (CEB) for a period of 20 years, with a 3-tier tariff, starting at LKR 22.53 for the initial 8 years, followed by LKR 8.19 for years 9 through 15. From year 16, LKR 1.62 will be paid as the tariff, with an additional LKR 2.46 for O&M. At present, CEB is the sole purchaser of power, with no alternative sales options available.

Incentive Mechanism

As a government policy initiative, the Ministry of Power and Energy has set a target of 10% of renewable power by 2015. Apart from the tariff, which is attractive at present, there is no other incentive mechanism available in Sri Lanka to promote wind energy at this time.

Also, the Sri Lanka Sustainable Energy Authority is responsible for issuing permits for setting up renewable energy projects, including wind energy, and for determining the tariff.

Appendix II: CDM for Wind Projects[72]

The United Nations Framework Convention on Climate Change (UNFCCC) was held in 1992 to address the issues surrounding climate change and their implications. Developed countries, referred to as Annex I countries in the Convention, were given emission reduction targets. The Clean Development Mechanism (CDM), developed in 1997 at the Conference of Parties under the UNFCCC, is a market mechanism to encourage the sustainable development of developing countries, referred to as Non-Annex I countries, in a way that reduces greenhouse gas (GHG) emissions.

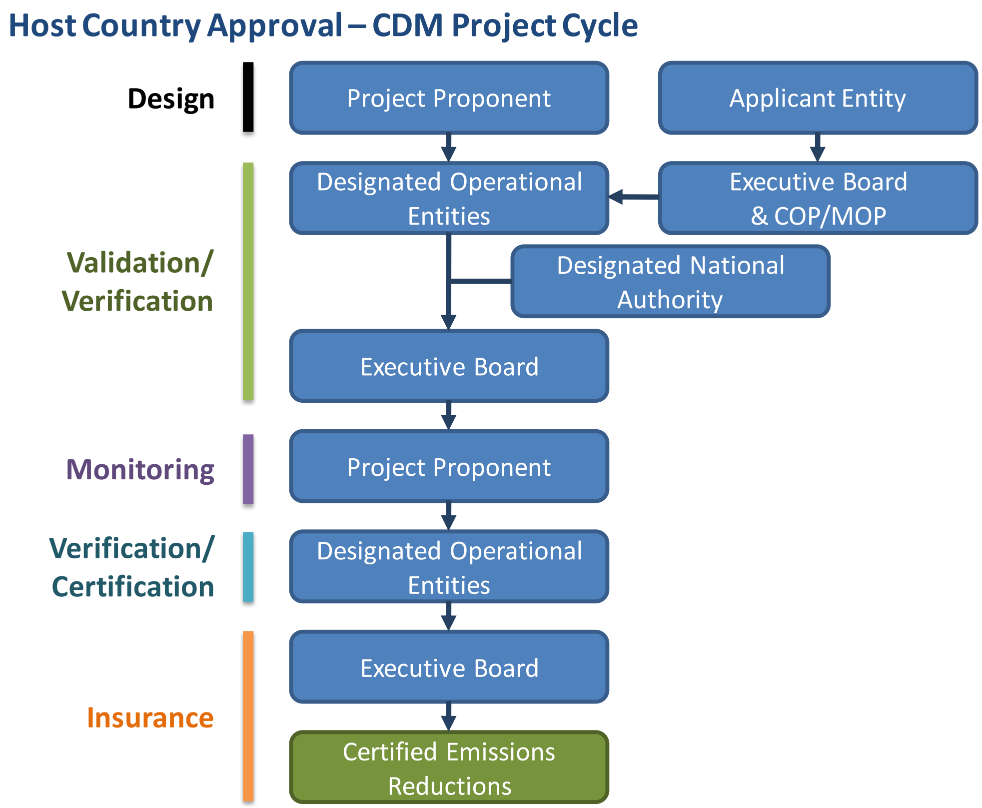
The CDM, as defined in Article 12 of the Kyoto Protocol, allows a country with an emission-reduction or emission limitation commitment under the Kyoto Protocol (Annex I of UNFCCC) to implement emission-reduction projects in developing countries. The CDM is the first global, environmental investment and credit scheme of its kind, providing a standardized emission offset instrument called a Certified Emission Reduction (CER).

In order to participate in the CDM, there are certain eligibility criteria that countries must meet. All parties must meet three basic requirements: voluntary participation in the CDM, the establishment of a national CDM authority, and ratification of the Kyoto Protocol.

The CDM is supervised by the CDM Executive Board (CDM EB) and is under the guidance of the Conference of the Parties of the UNFCCC. The Executive Board supervises the operation of CDM and has the final say on whether a project is approved or not. It also lays out procedures and guidelines for CDM. The figure below outlines the procedures involved for a successful CDM project.

[72] Source: Supporting Wind Power Take-off in the SARI/Energy Region, Draft Report, Prepared for USAID India, Prepared by Tetra Tech India, December 2010.

FigureII-1. The CDM Project Cycle



II.1 The CDM Project Cycle

The CDM project cycle starts with the development of Project Concept Note (PCN), which is submitted to the national CDM authority. Based on the PCN, the authority approves or denies the project (this is an essential step for registering the project with the CDM EB). A typical wind CDM PCN contains basic information about the project, such as capacity planned and location details.

The most important step in developing CDM projects is the preparation of the Project Design Document (PDD), which provides all the information about the project. It also contains a description of the baseline methodology and how the project satisfies the additionality criteria. ("Additionality" means that the project is additional to what would have happened in the normal course of policy implementation and technological development; it is intended to prove that the project would not have been implemented without CDM benefits.)

II.2 Baseline

The baseline is the emissions that would occur in the absence of the proposed CDM project, and it must be developed for the project. A number of baseline methodologies have already been approved by the CDM EB; they can be used if the project is similar to the project for which the baseline has been approved. There is also an approved simplified methodology (ACM 002) that most small-scale (less than 15 MW) wind projects can use. While the ACM 002 provides a number of baseline options, the proposed project must provide baseline data related to emissions from other generating sources, primarily thermal power generation, in addition to generation data.

The development of CDM projects and their construction can occur in parallel. The best time to initiate CDM project development is at the time of project conceptualization and certainly before the investment decision. Table II-1 provides the approximate timing for the steps involved in CDM project development, up to the issuance of CERs.

Table II-1: Approximate Time Line for CDM Cycle

No.	CDM Project Cycle	Time Schedule
1.	Preparation of project idea note and project concept note	2 weeks
2.	Preparation of project design document	8 weeks
3.	Host country approval	6 weeks
4.	Public web-hosting	4 weeks
5.	Site visit for validation	1 week
6.	Addressing draft validation report	20 weeks
7.	Request for registration	4 – 8 weeks
8.	Web hosting at UNFCCC	4 weeks
9.	Registration	2 weeks
10.	Monitoring	52 weeks
11.	Preparation of monitoring report	1 week
12.	Site visit for verification	1 week
13.	Web-hosting of verification report	2 weeks
14.	Request for issuance of CER	2 weeks
15.	Issuance of CER	2 weeks
Total Time required for receiving CDM revenue		110 weeks

II.3 Wind Energy and CDM

In the renewable energy sector, one of the major beneficiaries of CDM is wind energy, especially in countries like India and China. By mid-2010, energy projects totaling some 31,000

MW of installed capacity have applied for CDM registration. Of these, 1,665 energy projects have been registered. In the SARI/Energy region, India leads wind power project registration with some 104 wind projects now registered.

Wind power projects, like any other renewable energy project, have high initial investment requirements with longer payback periods, which increase project risk. Various governments have provided incentives to overcome this risk. Registering a wind power project as a CDM project also provides additional revenue through the sale of CERs generated from the project. A number of financial analyses have found that CDM revenue is capable of raising the return on a wind project by 3-4%.[73] Thus, CDM would help projects that fall just below the viability benchmark in terms of IRR, to become viable.

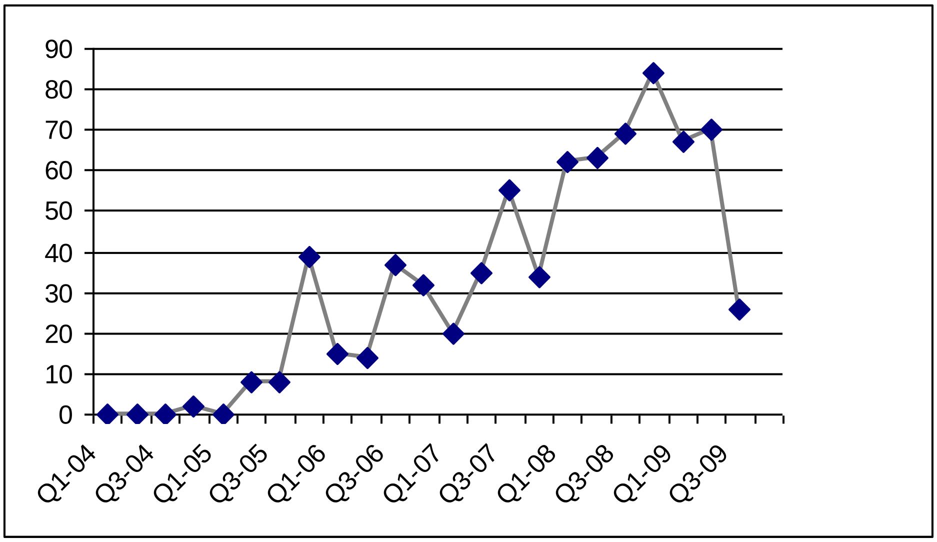
II.4 Current Issues

Of late, wind power projects have scrutinized by the CDM Executive Board. The primary reason for this has been the continuous changes in the modalities and procedures of the Board in an attempt to make the entire system more stable. The huge inflow of non-additional wind projects under the CDM was also a spur. As a result, many changes were made to the existing rules and regulations for CDM projects.

Figure II-1shows a decreasing number of wind power projects in the CDM pipeline. When it comes to India, about 755 MW of wind power projects have not achieved registration. These projects have either been rejected by the Executive Board, been withdrawn by the developers, or given a negative validation report by their respective Departments of Energy, or the developers have terminated the project themselves. Out of these, projects comprising almost 600 MW had started the validation process during 2006-2008. Clearly, the frequent and drastic changes brought about during this time have adversely affected the projects in the pipeline.

[73] http://cd4cdm.org/Publications/WindCDM.pdf

FigureII-1. Number of Wind Power Projects Registered under CDM Annually[74]



Serious Consideration of CDM Revenue

Recently, the CDM Executive Board released a guideline to establish that project promoters consider CDM as one of the critical sources of revenue before seeking investment in the project. This guideline, which also leaves much open to interpretation, greatly affected projects that either started the CDM process recently or have not been able to complete their validation. The worst affected are projects that were already in the pipeline or in advanced stages of validation. As a result of the release of this guidance, the validation for existing projects was started all over again. There have been a number of cases when even after the submission of number of official documents; the project promoters have not been able to convince their Department of Energy of the worth of their project. The result has again been either a rejection of the project or a delay in project execution.

Common Practice Analysis

The common practice analysis is an additional test that large-scale projects (above 15 MW) need to complete following the financial additionality principle. The test basically establishes the fact that wind power projects without CDM are not a common practice within a particular area or a jurisdiction, e.g., a State or province. For CDM wind power projects, this becomes a problem, especially in the Indian states of Tamil Nadu, Karnataka and Maharashtra, which have the largest number of wind project installations. However, this would not be a major problem in other South Asian countries, which currently have few wind installations. Although many developers appear to be familiar with CDM rules and claim to have applied for CDM registration, there is little quantitative data on the number of submissions and their status. With the CDM Board increasing their standards for compliance, the need for additional data development will be critical.

[74] UNFCC, CDM Projects Search, http://cdm.unfccc.int/Projects/projsearch.html, CDM project pipeline, 2010.

Increased Transaction Costs and Other Procedural Issues
The transaction costs for getting a project registered have seen a multifold rise. This can be attributed to the increased number of rules and regulations in CDM, and the simultaneous rise in the number of CDM projects. This is especially true in the case of the validation/verification fee, which has increased by at least 50% over the past four years. This issue is further magnified because of the fact that CER prices have been falling. If this trend continues, small-scale project promoters might not feel encouraged to apply for CDM revenue at all.

Table II-2. Typical Costs for a CDM Project

S. No	Description	Cost
1	Project development charges	US$ 10,000- 15,000 + Success Fee 0.5-5%
2	Validation charges	US$ 13,000– 20,000 (one-time fee)
3	Monitoring &verification charges	US $ 8,500 – 10,000 (Every Year)
4	UNFCCC registration charges	0.1 US$/CER up to 15,000 CERs, 0.2 US$/CER after 15,000 CERs
		No charges if annual average is less than 15,000 CERs
5	Adaptation fund fee to UNFCCC	2% CERs per annum
6	Carbon exchange fee (If CER transacted through an exchange)	2 – 5 % of CER transacted

II.5 Voluntary Emission Reductions: A Feasible Alternative

Due to the procedural and technical issues associated with the CDM, many project developers, especially those of older installations, are steadily moving towards other voluntary standards. Many of these standards hold promise as good alternatives to the stringent CDM rules and regulations, and allow wind projects to begin realizing revenues in less time than they would under CDM. Initially, the voluntary market was looked at for pre-registration credits or projects rejected by CDM. Now, an increasing number of people are making a conscious decision to move ahead with the voluntary carbon market for their projects.

Currently, two standards are dominant in the voluntary market: The Voluntary Carbon Standard and the Chicago Climate Exchange. These standards do have a disadvantage, however: because they are not as stringent as those in the CDM, the price that the voluntary emission reductions fetch is quite low as compared to CERs. At present, a Voluntary Carbon Unit (from the Voluntary Carbon Standard) and a Carbon Financial Instrument (from the Chicago Climate Exchange) are being traded at approximately 4€ and $2 per instrument, respectively, as compared to a CER, which is being traded at around 14€ (the spot market price on 5 September 2010).

On the other hand, the future of projects that were recently, or are currently being, commissioned is beginning to look brighter under the CDM. Post-2012, such projects are likely to be registered with minimum difficulty. In addition, the CDM's new Gold Standard is a qualifying project standard with a focus on sustainable development. A Gold Standard project is likely to earn a premium of at least 3-4€/ CER above the usual CER prices.

While the opportunity for increased CDM support for wind projects is substantial – clearly a large proportion of the more than 5,500 MW of the development pipeline could benefit from CDM – the opportunity has not been fully explored by the region's governments and policy makers. CDM remains a powerful tool to further augment private sector investment in wind power and Power Ministries should fully support project registration.

II.6 CDM Best Practice

Besides proving a project to be additional, certain practices can facilitate the registration of a CDM project. For example, informing the CDM Executive Board and the National CDM Authority early about the possibility of developing a project (even if it is only at a conceptual stage) will provide evidence that the project was conceived with CDM at the earliest stages. Further, good documentation is key to speedy registration, as the facts and figures mentioned in the CDM PDD often require third-party documented proof. Last, the timely appointment of consultants and a validation agency will increase the probability that the project will be registered successfully.

Appendix III: Wind project development checklists[75]

This appendix was adapted from Soren Krohn's paper "Wind Power Projects in Developing Countries: Key Barriers and Solutions for Wind IPP/BOO Projects," September 2010.

III.1 Policy and Regulation

The *economic* feasibility of developing large-scale wind energy depends primarily on having high wind speeds on sites accessible to electricity transmission equipment and roads, and on the economic cost of alternative forms of power generation. The *practical* feasibility of large wind projects, including their financing, is highly dependent on having an adequate legal and regulatory framework. The tables below list typical barriers cited by developers and possible ways to address them. Some solutions apply only to projects tendered on the basis of a tendered independent power project/build-own-operate project (IPP/BOO project), whereas others apply to fixed-price feed-in tariffs (FIT); this is noted in the text below.

Institution and Capacity Building, First Pilot / Demonstration Project		
	Barrier	Possible Solutions
1	Many government agencies are involved in the regulation of wind, but there is little effective coordination	In order to succeed in building projects, wind power needs to be high on the political agenda. Many governments have had success in setting up an effective inter-agency task force to fill in the missing pieces of the legal and regulatory framework. The task force should consult with the wind industry to clarify technical issues.
2	It is difficult to create comprehensive legal and regulatory environment for wind sector development	This difficulty maybe overcome to a certain extent by tendering an IPP/BOO project internationally, and in areas where regulation is missing, do "regulation by contract." If properly prepared, e.g., grid interconnection requirements can be recycled as a general grid code for wind turbines and wind farms.
3	Government/utility pre-development of tendered IPP/BOO projects is necessary if projects are tendered on predetermined sites	The government/utility should ensure that a grid study and a complete preliminary environmental and social impact assessment have been completed before bids are due. Otherwise, the winning bidder may be blocked by, e.g., missing environmental permits. Final site measurements are most efficiently done by pre-qualified developers.
4	It is critical that meteorology	Wind power needs far more precise wind speed measurements

[75] Source: Supporting Wind Power Take-off in the SARI/Energy Region, Draft Report, Prepared for USAID India, Prepared by Tetra Tech India, December 2010.

Institution and Capacity Building, First Pilot / Demonstration Project		
	Barrier	Possible Solutions
	masts be correctly installed in accordance with the IEC standard and equipped with MEASNET or equivalent calibrated quality instruments	than those needed for weather forecasting: An error of 1% on the mean wind speed may translate into a loss of 3% of power generation. The first meteorology masts in the country should be installed by certified international wind measurement consultants, and local staff should be trained to erect and maintain masts (guy wire tensioning, visual inspection, safe data collection). Local cellular phone mast erection contractors often have staff that can be trained for this purpose.
5	Technicians for turbine O&M are not available	First-rate turbine suppliers will train local staff to do routine O&M work. Experienced operators of diesel gensets or engineers managing ship engines are excellent candidates for this type of work.
6	Procurement expertise in relation to wind IPP/BOO projects is missing	Training programs are required. Because thermal projects are technically and economically different from wind projects (wind projects resemble small run-of-river hydro projects to a certain extent), some specific wind expertise is required in writing requests for proposals and assessing bids.

Economic Barriers for Wind at Power Generation Planning Stage		
	Barrier	Possible Solutions
1	Market failure to include externalities in the financial analysis of wind projects	Government should have utilities include externalities when analyzing economics in power generation planning in order to obtain the true social cost of power generation.
2	Competition from subsidized fuel for conventional thermal power	The utility's economic analysis / excess cost compensation mechanism should include the true opportunity cost of fuel savings (fuel can be exported or imports reduced, and there may be savings on fuel subsidies)
3	Improper or no accounting for fuel price risks in power systems planning makes countries choose short-term, low-cost solutions without regard for long-term risk	Power system planning models such as WASP (not to be confused with the wind resource analysis model, WAsP) systematically choose minimum-cost solutions with high risk, even if alternative lower-risk solutions are available with a minimal cost increase. Sensitivity analyses based on varying the rate of discount do not reveal this very real risk. Models exist for calculating the historical tradeoff between costs and risks for power generation portfolios and portfolio optimization. (The World Bank's ESMAP model for assessing fuel price risk in power systems planning is in the public domain. More recent versions are available, but such modeling requires additional training.)
4	Dominance of conventional	One key advantage of wind, hydro and geothermal projects are that

Economic Barriers for Wind at Power Generation Planning Stage		
	Barrier	Possible Solutions
	thermal power allows fuel price risks to be passed onto clients - or de facto absorbed by public budgets	the fuel is free, and that the electricity offtaker can do 20-year fixed price contract for electricity supplies.
5	Electricity markets not geared to wind	“Gate closure times” in electricity markets (i.e., the planning horizon for power generation in number of hours between the time power plants offer their electricity for sale and the time when it has to be delivered) may be too long to benefit from short-term wind energy forecasting. Gate closure times should be shortened to what is technically necessary for actual dispatch.

Energy Tariff & PPA Issues		
	Barrier	Possible Solutions
1	20-year take-or-pay PPAs unavailable	Wind energy is extremely capital-intensive, so long-term (basically) fixed-price PPAs are a necessity to obtain a reasonable price per kWh, regardless of whether the tariff is determined by a tender or by a feed-in scheme. Since the technical lifetime of a wind farm built according to IEC standards is 20 years, the lowest prices can be obtained if the owner can get a PPA corresponding to the technical lifetime of the plant. Changes to tariffs in feed-in based tariff systems should only apply to new projects, where investments have not started.
2	Feed-in tariff may be modified politically at any time	(shared cell with 1)
3	No sustainability of tariff scheme	The costs of wind energy can met by spreading them on the electricity tariff base, placing a levy on transmission, a renewable energy fund, or initiating compensation for the true opportunity cost of fuel saved from power generation.
4	Creditworthiness of the electricity offtaker is inadequate	Projects may need to be backstopped by partial risk guarantees (political risk and general payment risk) from MIGA or export credit insurance organizations.
5	The fixed feed-in tariff or RE bonus per kWh is inadequate to ensure the profitability of projects	It is difficult to determine the appropriate level of a feed-in tariff in a new market, i.e., a tariff that is adequate, yet does not give excessive profits on the best sites. Some mitigation can be obtained through tariffs, which are differentiated by wind resource or profitability (the Danish, German or French models). The best way to determine a commercially viable tariff is to start with an IPP/BOO demonstration scheme and tender a few wind farms on the basis of the kWh price under such a scheme.
6	Wind energy cannot compete financially due to subsidies to fuels for power generation	If fuel subsidies cannot be reduced, compensation mechanisms can be implemented for the electricity offtaker (for, e.g., domestically produced fuel freed for export or saved) rather than being given as

Energy Tariff & PPA Issues		
	Barrier	Possible Solutions
		subsidized fuel for power generation.
7	Economic incentives are inadequate, (taxation, etc.)	Basically this is a question of determining an appropriate tariff - by tendering or a fixed-price feed-in tariff (FIT). Special incentive schemes may serve to make the pricing/tariff issue less transparent.

Permitting and Licensing Issues		
	Barrier	Possible Solutions
1	Unexpected permitting and licensing requirements may wreck an otherwise fully developed wind project	Permitting/licensing requirements should be built into requirements for BOO projects, so that the winning bidder will have demonstrated compliance with the requirements for obtaining permits/licenses. For price-based tariff schemes (FIT) a “single window” approach (a single government agency that coordinates all permitting requirements) is extremely useful. This has been done for offshore wind with success in Denmark and elsewhere, often through national energy agencies or national investment authorities.

Public Land Use Policy		
	Barrier	Possible Solutions
1	Exclusivity arrangements with developers (often land speculators) lock up valuable high-wind resource land, which remains undeveloped	In fixed-price FIT systems, it is best to have competition for land use (auction based on rent per MWh), with annual land rent to be paid in any case, until the project is commissioned. It is definitely necessary to have a time limit for a land lease expiry before commissioning occurs. Possible model inspiration may be obtained in Ireland's offshore wind territory lease system. For tendered BOO/IPP projects on sites to be found by developers, non-exclusive letters of intent of governments for land leases can avoid the lock-up problem during the bidding phase. (A good example is the Government of Québec.) For tendered BOO/IPP projects on predetermined sites, the issue does not arise (only one bidder will win the right to use the site). Land speculators may not be helpful to the process of building a viable pipeline of projects. In that case, access to public lands should be limited to pre-qualified, bona fide developers, with sufficient technical and economic qualifications. (This is usually done in all tendered IPP/BOO projects.)
2	Land rent	If any land rent must be collected, it is best (because it presents the

Public Land Use Policy		
	Barrier	Possible Solutions
		least risk for the developer and thus the lower acceptable tariff) if the annual rent is based on actual energy production, i.e., on an amount per MWh. In quantity-based systems (tendered IPP/BOO projects) land rent will be reflected in the bid price, hence zero rent for public land may be optimal in price-tendered projects. It is usually necessary to specify a minimum number of MW for the particular land area to ensure the efficient use of valuable high-wind resources. (The number of MW varies with the terrain's surface roughness, topography and wind climate, and requires expert advice.)

III.2 Wind Project Development

The tables below list typical barriers cited by developers and possible solutions. Some solutions apply only to projects tendered on the basis of a tendered IPP/BOO project (on the basis of the kWh price), whereas others apply to fixed tariff systems (FIT); this is noted in the text below.

Wind Resource & On-Site Measurements		
	Barrier	Possible Solutions
1	Lack of knowledge of national wind resources and probable generation costs	Meso-scale wind atlas based on satellite data, weather model reanalysis data, and meteorology models. Preferably also a national ground-based meteorology mast measurement program to verify this modeling. This can be used as a basis for further exploration and measurements on potential sites. World Bank (ESMAP) guidelines for terms of reference are available for meso-scale wind atlas mapping. Developers or land speculators who have measured before others (and frequently taken out options for land leasing) often consider this a low priority, since they prefer to remain in a situation where they have an effective knowledge monopoly and can lock up the best land with good wind resources.
2	Lack of reliable long-term wind data makes wind energy resource estimates uncertain	A government-run long-term wind measurement program for each relevant region may be needed. Good examples are the DANIDA and GtZ-financed program in Egypt, which has been operating for >15 years, and a GtZ-financed program in 12 regions of Syria, which has been operating for> 5 years. (Poorly planned & poorly managed wind measurement programs abound in many countries on several continents.)

Wind Resource & On-Site Measurements		
	Barrier	Possible Solutions
3	The government does little or no pre-development work for potential sites, and little or no regulatory work related to wind energy	Pre-development work on promising sites with good wind resources, grid access and good accessibility makes sense only if the sites are tendered competitively (by bidding for a MWh price). If the site is thus pre-selected, it is important that the government take on all the project risks under its control in order to minimize the risk for bidders and their MWh price. Prior environmental impact assessment, screening is also necessary. The regulatory framework needs not be complete for the first projects; the problems may be solvable by "regulation by contract." (See Section III.1.) If developers are to find sites on their own, then logically pre-development work is the developer's responsibility, for example, in a classic FIT system. In this case, however, it is necessary that the legal and regulatory framework has been properly established, dealing with all the issues listed in these tables (and more).
4	Moral hazard problem if the electricity offtaker (government or utility) has measured wind on a predetermined site to be tendered as an IPP/BOO project: There is an incentive to exaggerate the wind resource, and the quality of measurements may be insufficient, making it too risky for financiers.	Bidding developers, not the electricity offtaker, should measure wind on sites tendered for IPP/BOO projects, since the developer takes the wind resource risk. An operational model for a voluntary joint site measurement program for pre-qualified bidders has been developed in Egypt for its 2,500 MW IPP/BOO wind program. This model is now also being copied in Syria.
5	Low quality of wind measurement and sketchy resource modeling requirements in tendered IPP/BOO contracts increase project risks	The quality requirements of the developers and their financiers are the determining factor in whether a project succeeds. Hence, it is preferable if minimum quality standards correspond to the bankers' requirements. This is the basis for the mandatory measurement requirements in the Egyptian IPP/BOO tender model mentioned above. Likewise, resource modeling using WAsP or other internationally bankable software should be required. Otherwise project financing may be impossible to obtain.
6	Poor or no digital topographical high-resolution maps are available for sites being tendered as IPP/BOO projects. This increases risks in resource modeling and consequently bid prices.	The Egyptian tender model includes advanced aerial laser scanning of sites. There are economies of scale in site mapping, however, and governments could digitally map multiple sites as part of their pre-development work for tendered IPP/BOO projects. There is more trust in the offtaker doing this type of measurement work than in their wind measurements, since topographical measurement quality can be verified ex post, whereas wind resource assessments can only be verified after the wind farm has

Wind Resource & On-Site Measurements		
	Barrier	Possible Solutions been built.
7	No geotechnical sampling prior to tendering sites increases risks for bidders (foundation costs).	The Egyptian tender model mentioned above includes geotechnical sampling.

Environmental and Social Impacts		
	Barrier	Possible Solutions
1	Wind development competes with other land uses in the province/region	A nation program of pre-screening relevant regions for environmental and social issues (e.g., birds, telecommunications, archeological sites, waterways), as well as preliminary environmental impact and social assessment studies, is recommended. Map layers can be combined with the wind atlas and generic grid reinforcement cost map to find suitable development areas.
2	Project risk regarding whether environmental and social impact assessments will be positive or not	For IPP/BOO projects at predetermined sites, the government should do preliminary environmental impact and social assessment studies, ensuring a near-certain approval of project.
3	Private land use: Poorly defined property rights or indigenous people's rights	A land registration program may be needed to determine property rights in the area of the site. Special problems can arise when handling collectively owned. There is extensive literature on the subject available from the World Bank (and its upcoming publication on best practice for handling environmental and social issues in relation to wind farms) and other sources.
4	Private land use: Landowner resistance to the project	It is important that all landowners within wind farm perimeter receive some sort of compensation per turbine on their land plus compensation for access roads. In some jurisdictions transmission mast compensation rules can be used as a model. Even landowners without turbines or road use should receive some (lower) compensation to avoid political blockage of project from non-compensated landowners. Good elaborated model guidelines were issued in Ontario, Canada.
6	Laws or resistance against land being taken out of farming	Land need not be purchased for wind farms, but can be leased for the duration of the PPA, and legislation and regulations should allow this. Close to 98% of the land area will remain arable after a wind farm has been installed.
7	Local resistance to the project due to lack of information / participation	Community income sharing schemes have been implemented in other power generation projects. Best practices for local information / hearing practices can be obtained from, e.g., ADB, IFC or World Bank safeguard guidelines.
8	Concerns about safety for	All wind turbines installed in the country must be required to be

Environmental and Social Impacts		
	Barrier	Possible Solutions
	neighbors and workers on site	type certified for a technical lifetime at least equal to the duration of the PPA by an accredited entity in accordance with the most recent version of the IEC 61400 standards as fit for purpose in the site environment.
9	Ornithological concerns about bird or bat populations	Ornithological studies (1 year) may be required as part of environmental impact assessment (EIA) in critical areas. Mitigation measures may be needed (e.g., temporary stoppage during high-density migration, if the wind farm is placed in an important bird migration path). The determination of whether an area needs additional studies is best done in the environmental screening phase (point 1 above), where zones may be labeled as red (prohibition), yellow (bird studies required), or green (no bird studies required).

Public Spatial Planning (Zoning)		
	Barrier	Possible Solutions
1	Poor site area planning leads to interference (wind shading) between wind farms, and increases risks and required tariffs needlessly (this is a common problem in very high-wind zones with densely packed wind farms)	Wind farms generate turbulence downstream, and turbulent energy cannot be used for power production. It is essential that wind farms be carved out so that they do not shade one another. An upstream wind farm will reduce energy production downstream by 10-20% depending on turbulence intensity and terrain surface roughness. Poor site planning also means that use of the wind resource will not be optimized, possibly wasting 15-20% of the energy and with correspondingly higher required tariffs. Adjacent wind farms should be long slices in the prevailing wind direction, with the borderline following the prevailing wind. Buffer zones for wind to recover are required between wind farms, notably downstream. A single large wind farm optimized by a single owner will usually exploit the land area best.
2	Poor site planning in relation to noise and shadow flicker may cause problems with neighbors and cause sites to require re-planning	There is excellent software on the market (e.g. WindPro, Wind Farmer) that can be used to define appropriate distances between turbines and residences to meet a regulatory requirement that the theoretical noise level will not exceed, say, typically 40 dB(A) (this maximum limit needs to be defined in regulations). Likewise, shadow flicker is only a real problem in a narrow strip southeast of each turbine (in the Northern hemisphere). Exclusion zones can be mapped using this standard software. (Again, the acceptable maximum number of shadow flicker hours needs to be defined in regulations).
3	Military or civil aviation authorities may object to siting	Rules for aerial markings on tall wind turbines need to be established. Good standard models for this are available (red/white stripes on blades, and for very tall turbines, night lighting). But

Public Spatial Planning (Zoning)		
	Barrier	Possible Solutions
		concrete decisions may need to be taken in relation to topography (mountain ridges) and proximity to air corridors (e.g., end of runways in airports are off limits, but no major problems elsewhere around airports).
4	Telecommunications authorities may object to siting	Turbines should not be placed directly in microwave transmission corridors. Standard rules are available for this. Otherwise, there are generally no major radio or TV interference problems. Wind turbines often have double use as towers for cell phone communications.
5	Road authorities may object to siting	The setback from roads is usually regulated to be about 100 m.
6	Decommissioning requirements for wind farm undefined, risk of ghost wind farms	Decommissioning requirements should be defined in the PPA or regulated generally. The best practice is to require that foundations are removed to 1 m below grade and that land is restored to its original state after the PPA ends. Any turbine that has been out of service for a year must be removed from the site and the terrain restored when decommissioning. A security/guarantee arrangement for this (bond) is useful to include in the RPF documents or the PPA.

Experience/Capacity for IPP/BOO Projects		
	Barrier	Possible Solutions
1	Disagreement about which party bears which risks in IPP/BOO contracts	Best practice for all tendered IPP/BOO contracts is that the party who effectively can control each risk or who most cheaply can cover it, bears that risk. For risks that are outside the control of either party such as exchange rate risks, and prices that affect project economics, they are usually most cheaply carried by the electricity offtaker. It is in the interest of the electricity offtaker to reduce project risks as much as possible in order to achieve a low electricity price. The offtaker will have an interest in doing as much pre-development as possible in the special case of IPP/BOO tendering on predetermined sites in order to reduce risk.
2	BOO or BOOT contracts?	According to IEC standards, wind farms have a standard certified technical lifetime of 20 years. PPAs should generally have a term of 15-25 years and a decommissioning requirement, and terminate thereafter. It is unwise to insert any option for the bidder to continue projects after this point, since economic conditions may change substantially in the meantime (giving windfall capital gains to project owner).
3	Price indexation of PPA contracts	The primary economic advantage of wind energy is that the electricity offtaker can do fixed-price electricity contracts for a 20-

Experience/Capacity for IPP/BOO Projects		
	Barrier	Possible Solutions
	(applies to FIT contracts as well)	year period. Wind farm projects should thus normally be done as primarily fixed-tariff (energy only) take-or-pay contracts for the duration of the PPA. Wind farm owners are safe with this solution, since they will take out nominal, not real (price-indexed) loans from their financiers. A small component limited to labor and parts content in O&M (maximized to about 15-20% initially) could be indexed. Exchange rate indexation is another issue treated under the finance section. Price indexation of bids between the time of bidding and financial close or commissioning is a separate issue.

Critical Mass Issues, Local Participation, Local Content		
	Barrier	Possible Solutions
1	High local content requirement beyond balance-of-plant (i.e. roads, foundations and electrical works) is not economic for small projects	The most important prerequisite for local manufacturing is to have a stable wind program with a time horizon of at least 5-10 years, and a credible continuity of national policy despite changes in government. Otherwise, it is too expensive to make investments and train local staff. Local manufacturing, particularly of small volumes, may imply significant cost and reliability penalties. Simple one-off programs in a single year will only generate local work on installation (balance-of-plant), but this may be quite significant: 20-35% of project investment.
2	Tower manufacturing is most amenable to localization for larger projects	Transportation costs often mean that towers can be manufactured locally economically for larger projects. Towers account for a relatively large share of the value of a wind turbine, about 15-20%. Local manufacturing requires ISO 9000-series certification of the supply chain.
3	Nacelle assembly is (mistakenly) seen as a valuable means of employment and technology transfer	Nacelle assembly accounts for around 2% or less of the price of a wind turbine. Hence, there is no economic gain, little employment and high quality risk associated with local manufacturing. The manufacturing process for wind turbines in not substantially different from other forms of large machinery manufacturing.
4	Rotor blade manufacturing requires high, continuous order volume	Rotor blade molds are expensive assets, which - like blades - are difficult to transport. Hence, they need to be run with high capacity utilization, i.e., the local market has to be relatively large and continuous. Raw materials normally need to be 100% imported. Blades typically account for 12-15% of the value of a wind turbine. Local manufacturing requires ISO 9000-series certification of the supply chain.
5	High local content is more difficult to achieve in price-	Annual volume is politically uncontrollable in a FIT system and in practical terms also uncontrollable in a green certificate system.

Critical Mass Issues, Local Participation, Local Content		
	Barrier	Possible Solutions
	based (FIT) system than in quantity-based tariff systems	Volume and suppliers can be controlled accurately in a pipeline of IPP/BOO tenders (or EPC tenders by the national utility/government).
6	Small project size fails to attract experienced international bidders and turbine manufacturers in tenders	Large, experienced international wind developers with good access to finance focus on projects in the 100-250 MW range, or on pipelines or bundles of projects from this size and up. Small projects below 50 MW may have difficulty getting turbines, if they are the first in a region without an established service network. A possible way of obtaining a critical mass of MW is to bundle several non-contiguous project sites into a single tender, as is being done in the Philippines.

III.3 Wind Power Transmission Grid Integration

The tables in this section treat the typical technical and administrative barriers to transmission grid integration of wind power in developing countries.

Typical Transmission Grid Issues in Developing Countries		
	Barrier	Possible solutions
1	Little or no knowledge of wind power characteristics, (e.g.,. assumption that wind power is intermittent 100%-0% in seconds rather than several hours)	Capacity building for TSO staff is required, including basic wind power technology, power quality and grid support properties of modern wind turbines, meteorology, and use of short-term wind forecasting in dispatch. The simulation of power generation should be based on historical local meteorology data and historical hourly load curves.
2	No existing standard grid code adapted for wind turbines or wind farms	A grid code for wind turbines and wind farms should be established based on mainstream large international markets, but adapted to local grid conditions. If the first project is an IPP/BOO project, define and subsequently recycle interconnection requirements as a general grid code.
3	Grid studies, including dynamic grid stability studies, are not available for the project	For larger wind farms it is necessary to include such studies in the transmission project related to the wind farm.
4	Weak grids and long radials to reach (often remote) windy areas require grid reinforcement / grid extension. Wind developer	It is extremely useful to prepare a generic grid reinforcement cost study for each (wind-relevant) section of the transmission grid (to be updated, say, after 3-5 years). This study will complement a national meso-scale wind resource

<table>
<tr><th colspan="3">Typical Transmission Grid Issues in Developing Countries</th></tr>
<tr><td></td><td>Barrier</td><td>Possible solutions</td></tr>
<tr><td></td><td>demands for grid connection in remote areas may be costly to meet.</td><td rowspan="3">map in order to search for economically suitable sites and begin local wind measurements.

A separate transmission queue is needed for an IPP project pipeline, with clearly defined responsibilities for the transmission system operator.</td></tr>
<tr><td>5</td><td>No clear responsibility for transmission systems operator to provide interconnection for IPP wind farms</td></tr>
<tr><td>6</td><td>Transmission master planning not adapted to IPPs: Long transmission project queue, often requiring waits of 3 years or more. Master plan revision is slow.</td></tr>
<tr><td>7</td><td>Wind projects are often required to bear the cost of grid reinforcement / grid extension, even if a stronger local grid or a grid extension to remote areas also benefits local consumers and the electrical utility.</td><td rowspan="2">The transmission grid should be considered a public good, to be financed through a “postage stamp” transmission tariff.

Central planning can be useful to make wind energy development take off: Governments and development banks can help finance grid extension to windy areas, where pre-assigned sites can be tendered as a pipeline of IPP projects.

Example: Egyptian Red Sea Coast, where 3,500 MW of IPP & government-owned projects will be built 300 km away from the main transmission grid. The Egyptian Government, World Bank, African Development Bank, EIB and KfW are financing the grid and EIA for the whole area.</td></tr>
<tr><td>8</td><td>First projects in a remote, high-wind area cannot bear the cost of grid extension, but additional projects could. This “chicken and egg” problem prevents wind development from taking off in potentially promising high-wind zones.</td></tr>
<tr><td>9</td><td>Auto-generation wind projects face problems of negotiating interconnection fees, wheeling and banking rights, and agreements on the cost of balancing power.</td><td>Replicable models have been developed in India and Morocco, for example.</td></tr>
<tr><td>10</td><td>Grid maintenance planning not adapted to wind IPPs: TSO may demand right to</td><td>IPP contracts need to be take-or-pay contracts, with damages to IPP equal to the actual lost production in case of any grid interruption, since the maintenance event is controlled by the TSO and can be</td></tr>
</table>

Typical Transmission Grid Issues in Developing Countries		
	Barrier	Possible solutions
	interrupt grid, say 1% of the hours of the year.	planned for the low-wind season. Otherwise, the developer may require some (1% / capacity factor) in the risk premium!
11	Connection requirements for small wind farms (connected at the distribution voltage level) are sometimes as demanding as for large wind farms connected to the transmission grid.	No technical need to apply transmission codes at the distribution voltage (MV) level.
12	Long "gate closure times" in electricity market / least-cost dispatch planning makes it difficult for wind supplies to be scheduled efficiently	Gate closure times can be shorter, limited only by technical requirements for dispatch. The dispatch center needs to run a short-term wind generation forecast model, if there is a high level of wind penetration in the grid control area. Larger IPP wind farms should be required to supply real-time wind data from on-site meteorology masts and generation and availability data from SCADA systems for the wind forecasting model.
13	Large concentrations of wind farms in remote areas put additional demand on grid management functions to ensure grid stability	Grid codes should provide for remote control of wind farms or clusters of wind farms by the dispatch center, e.g., for variable reactive power compensation, and in emergency situations where the possibility of energy curtailment ranges from 0-100%.
14	Capacity credit - if part of the tariff system - may discriminate against wind by assigning it zero capacity value	Wind does have a capacity value in the grid, which can be determined by simulation models including historical data for wind and electricity demand, and observing a given loss-of-load probability. These analyses indicate that for moderate amounts of wind in the grid, say, up to 20% by energy, the capacity value is about equal to the average capacity factor for wind power.

III.4 Financing and Costs

This chapter addresses financing and cost issues related to large-scale wind projects. There is a considerable overlap with the previous chapters, in particular policy & regulation and project development. The table attached below lists typical barriers to financing projects. Each subject is treated in more depth in the other chapters.

Examples of Major Risks for Wind Farm Financing		
	Barrier	Possible Solutions
1	Risk allocation between contracting parties	Risk should be carried by the party able to control the risk or to most cheaply mitigate the risk (e.g., the developer takes the wind risk, the government guarantees against regulatory changes with major economic impact). Risks beyond the control of either party (e.g., exchange rate risk, price index risk) are generally most cheaply carried by the electricity purchaser.
2	Developer qualifications: Insufficient experience, inadequate capital base	Form consortia with experienced companies
3	Electricity offtaker with little IPP experience and a poor credit rating	A contractual framework needs to be established in accordance with best international practice. Lack of regulatory framework can partially be remedied by "regulation through contract." A PPA may need to be backstopped by government guarantee and partial risk guarantee from credit insurance company / MIGA (political risk, payment risk).
4	Wind resource uncertainty, lack of long-term reference data, poor site measurements	Governments and development agencies can finance modern meso-scale wind atlas work based on satellite data, meteorological modeling and meteorological reanalysis data. Guidelines for ToRs are available from the World Bank (ESMAP). Due to poor long-term meteorology data in many developing countries, a ground-based long-term provincial measurement program is often needed to obtain reference data, which is used to calibrate measurements in order to find long-term mean wind speeds. There are good examples of such programs in Egypt and Syria. Bankable site measurements need to be done by certified consultants. At least 12 months of measurement if good, long-term reference data are available from nearby locations; otherwise, a longer time period for measurements is preferable.
5	Construction risk	Form consortia with experienced companies with local knowledge and experience.

Examples of Major Risks for Wind Farm Financing		
	Barrier	Possible Solutions
6	Land risk, property rights poorly defined, lack of government land use policy	Property rights programs for land registration may be needed, and a government land use policy is needed.
7	Environmental and social risks	Prior screening of land use by the government is extremely useful (good examples can be found in Denmark and Germany). Such screening may involve bird studies, mapping microwave corridors for telecommunications, aerial marking requirements close to airports, potential archeological finds, etc. Environmental and social impact assessments are needed, and mitigation measures may need to be implemented. Information and participation schemes for local communities, landowner compensation schemes.
8	Grid risk: Inadequate grid studies, including dynamic stability studies. Missing grid code or requirements that do not correspond to actual grid strength/stability	Grid codes for wind turbines and wind farms (preferably modeled on grid codes from major markets) are needed. Grid studies for site area are required to ensure technical feasibility.
9	Revenue risk: Poor creditworthiness of the offtaker, firm PPAs of 20 (or 15) years duration not available, tariff subject to political uncertainty	Firm PPAs of 20 (or at least 15) years with fixed prices are necessary to obtain an acceptable electricity price.
10	Tariff inadequate for rate of return and/or debt service coverage	Wind projects are very capital-intensive and require a (mostly fixed) tariff to service debt. Only O&M costs (max 15-20%) need indexation.
11	Power curtailment risk	Contracts must be take-and-pay and compensate for actual loss due to grid outages or grid maintenance. (Actual loss should be calculated from meteorology mast measurements on site and an empirical power curve for the wind farm.)
12	Availability and operations risk	Power purchaser should require quality turbines from experienced manufacturers that are IEC certified by an accredited entity as fit for purpose in the site environment. Turbine models that have proven high availability in previous large wind farm projects in similar climatic conditions are preferable. Sufficient manufacturer warranties and service contracts with training of local staff and manufacturer service team in region. Spare parts and consumable stocks are needed near the site.

Examples of Major Risks for Wind Farm Financing		
	Barrier	Possible Solutions
		An experienced wind farm operator with an appropriate training program for local staff is required.
13	Health & safety risks	Adequate health & safety program is required from the developer. Occupational safety requirements should be state-of-the-art from developed markets (e.g., fall protection, lifts in large turbines).
14	Inadequate legal and regulatory framework	In countries new to wind power, in particular developing countries, there is often a legal and regulatory vacuum. This makes it impossible to design projects so that they can be shown to be compliant with existing regulations, which may in turn make it impossible to finance projects. Developers are attracted to markets where the framework conditions are known, or where at least the government is aware of the regulatory gaps and capable of plugging them through contracts.
15	CDM/JI and other carbon finance is difficult to handle for developers	CDM/JI and other carbon finance is difficult to handle for developers, and hence attributed little or no value, when calculating their required tariff. Consequently, it is best for the government to handle carbon finance.
16	Depth of local long-term capital market insufficient	If it is not possible to obtain long-term finance in local capital markets, then contracts will have to be in hard currency - or indexed against hard currency.

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