2x10 MW Wind Power Plants in Sri Lanka

Case Study : Seguwantivu & Vidathamunai Wind Power Projects

One Success Story

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Agenda

- Background of the project
- Planning Phase: Estimated timeline, budget
- Development, Construction, Commissioning and Operation phases
- Actual timeline of project
- Plant Performance to date
- Our wish list

History of Wind Power in Sri Lanka

- 3 MW Pilot Wind Power Plant built in year 1999 in South by Ceylon Electricity Board
- Installed to explore possibilities in the future
- 5 Wind Turbines of 600kW each

1a. **Background of Our Project**

- Reasons for choosing to invest in wind project
  - We were already in to development of Small Hydro
  - Good wind potential identified as per NERL atlas of 2003
  - Offered a reasonably attractive Tariff
- The idea came with the opening up of wind sector for private developers by SEA & CEB in year 2008
- The project agreement signed on **09.09.2009**

Location of the Project

- At Puttalam in NW of Sri Lanka
- 123km away from Colombo, the capital

1b. Planning Phases

- Size of project – **2x10MW**
- Land acquisition for project – **from the Gov. on 30 year lease**
- Estimated Project timeline – **1 year**
- Consultants on the project - **None**
- Estimated Project Cost – **USD 35 million**

Uncertainties in The Project

- No proven commercial scale wind power projects
- No Banks were willing to fund 40% debt, even though we were ready with 60% equity
- Spent 3 months with consortium of local banks trying to negotiate funding
- Prepare 165 documents to satisfy foreign consultants

Infrastructure in the region

- A 15km, 33kV Transmission Line to be build up to the Grid Substation
- Initially to connect to the GSS at 33kV level, then upgrad to 132kV level at our cost
- Specialized trailers to be imported from India due to road limitations
- All cranes for wind turbine erection to be imported from India
- No difficulties at Port

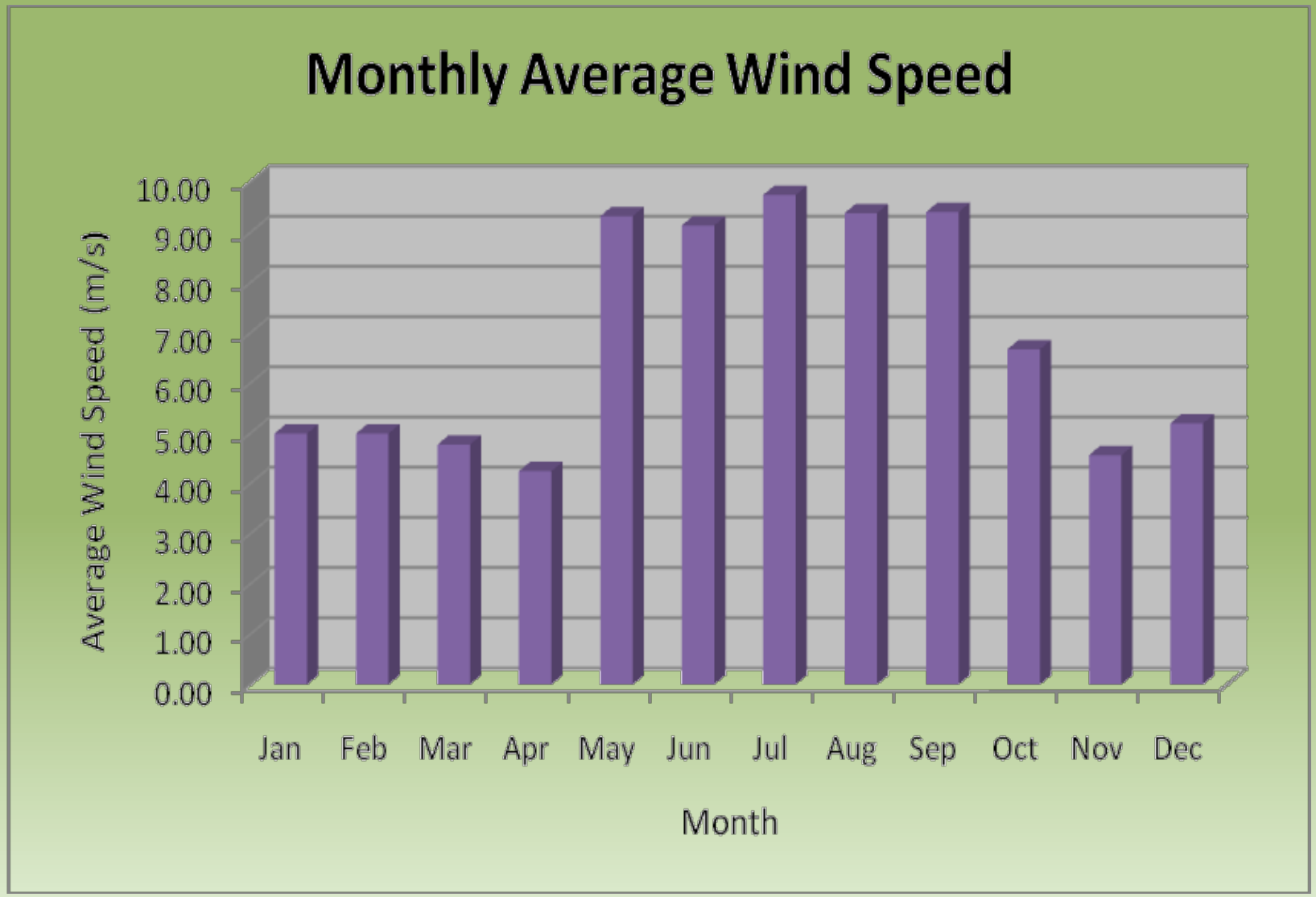
2. Wind Resource Assessment

Data used to analyze the feasibility

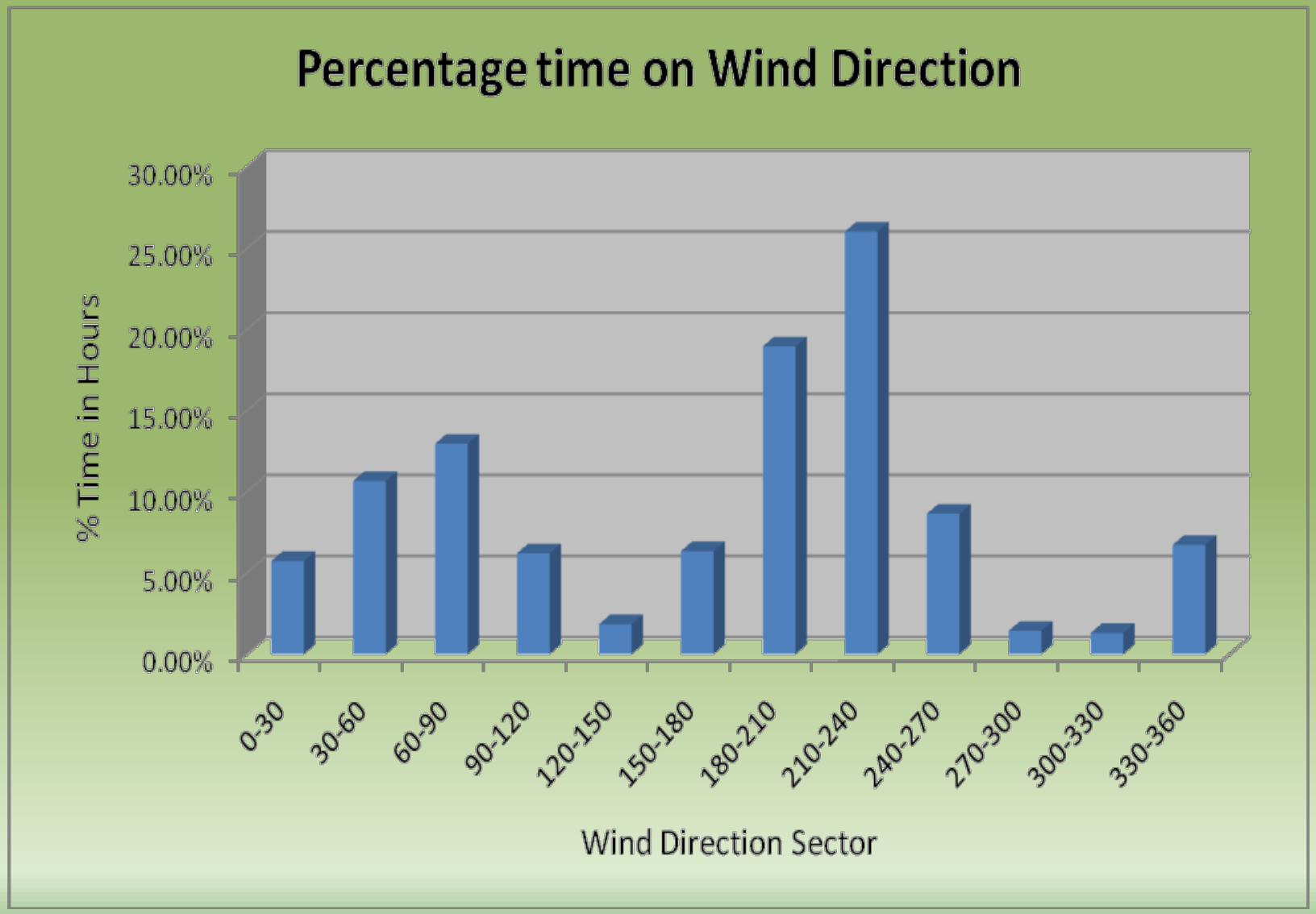
- Wind measurement data of CEB of year 2000/2001
- Wind Study done by U. S. National Energy Laboratory in year 2003
- Wind Measurements from wind mast installed by Sustainable Energy Authority at site, since March 2007.
- Satellite data obtained by WTG supplier from March'2002 to March 2007

Wind Mast at Site

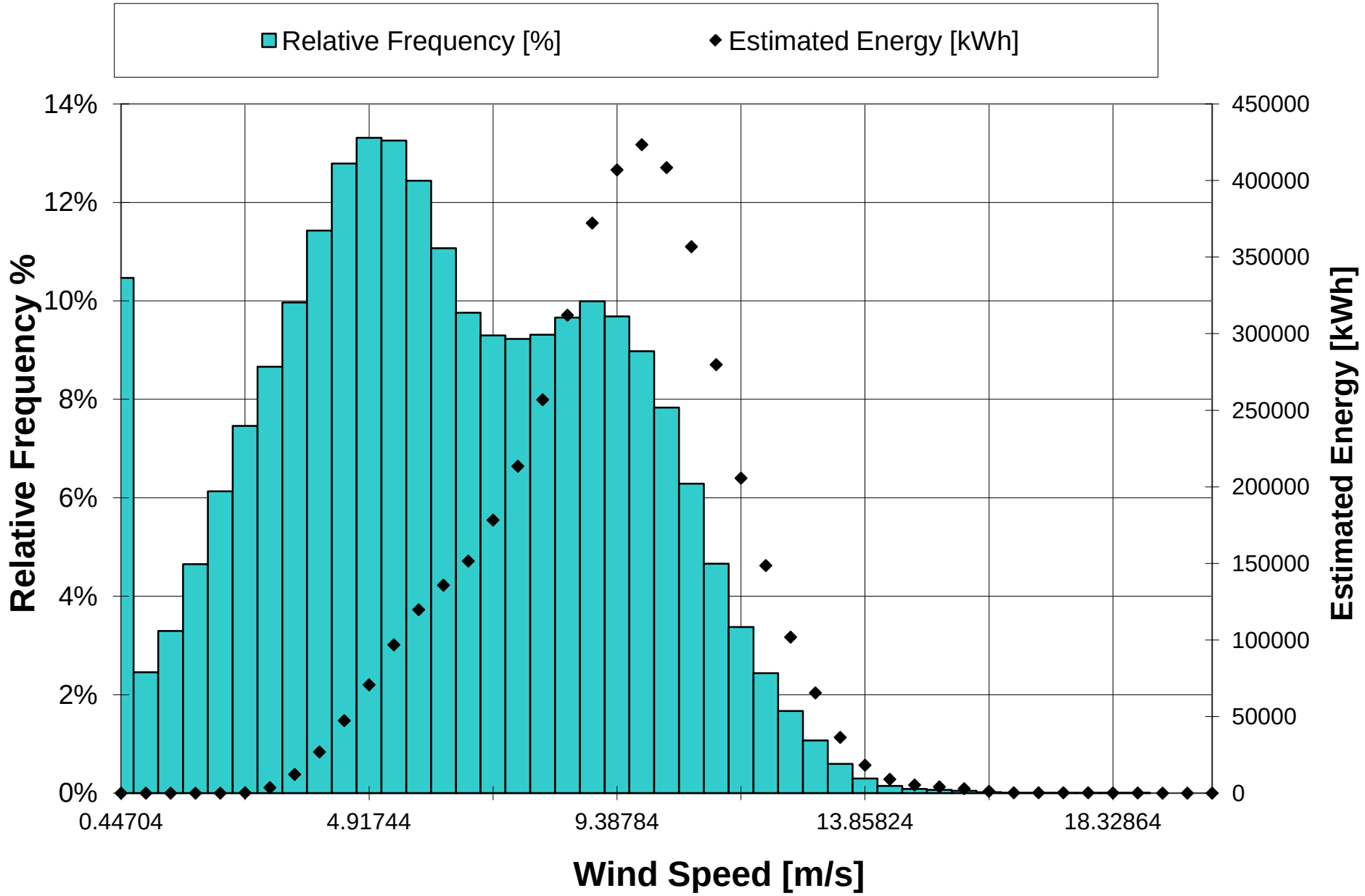
- Measuring equipment were from **Second wind**
- Wind data were available since March 2007 for 2 years
  - At 25m
  - At 40 m
  - At 50 m heights



At 50m height


Percentage time on Wind Direction
% Time in Hours
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
0-30
30-60
60-90
90-120
120-150
150-180
180-210
210-240
240-270
270-300
300-330
330-360
Wind Direction Sector

Frequency Distribution Graph



Wind Analysis Summary Report

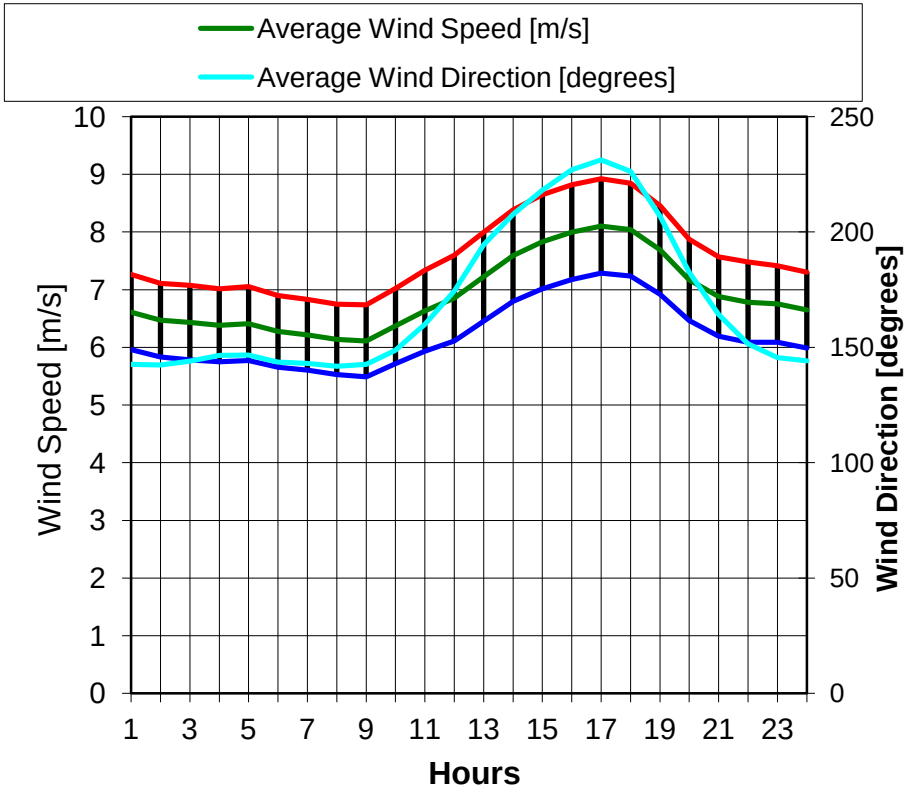
Site Information

Project:	Wind Measuring
Location:	Mullipurama
Site Elevation:	0.3 m
Averaging Time:	10 min

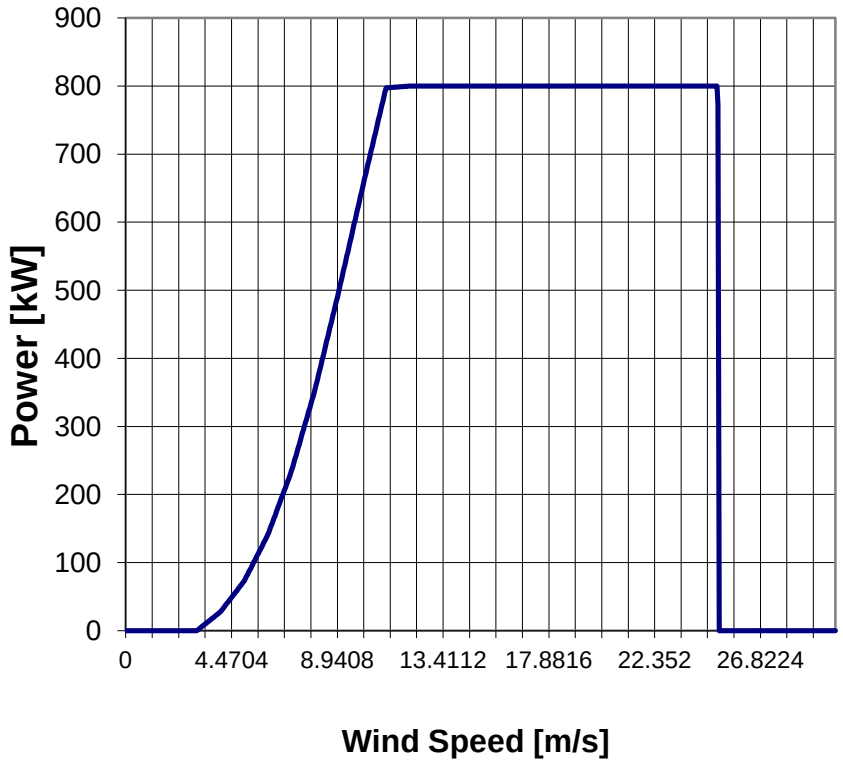
Sensor Information

Sensor/Tower Height:	50 m
Scaled Height:	60.5 m
Windvane Offset:	0 degrees

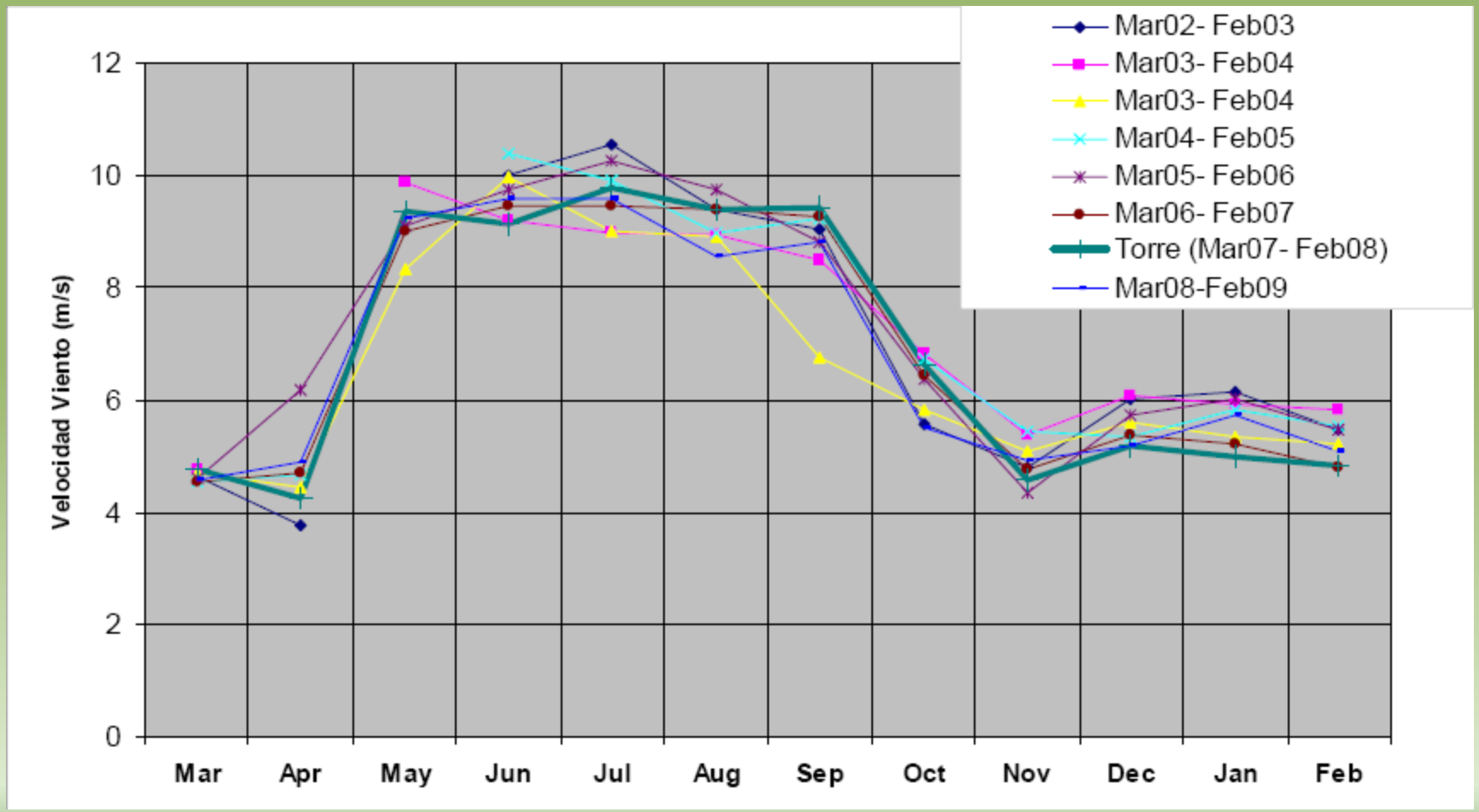
Diurnal Wind Speed Pattern



AE59-800kW



Long Term Correlation Chart



3a. Turbine Models Analyzed

Turbine Supplier	Gamesa	Vestas	Suzlon
Offered Model	AE-59	V82	S64
Turbine Capacity	800 kW	1650 kW	1250 kW
Rotor Diameter	59 m	82 m	66 m
Wind Class	Class III	Class IIB	Class III
Cut-in Wind Speed	3.5 m/s	3.5 m/s	3 m/s
Rated Wind Speed	11 m/s	13 m/s	14 m/s
Tower Hub Height	60 m	78 m	74.5 m
Tower Type	Tubular Tower	Tubular Tower	Tubular Tower
Generator Cooling	Air cooled	Water Cooled	Air cooled

Why We Selected Gamesa ?

- One of the most reputed manufacturers in the world
- Best Energy Yield for the wind pattern at site
- The offered WTG size of 800kW is ideal for logistics
- Less risk on revenue on WTG failure
- **Only WTG which 100% complied to CEB Grid code at that time,**
  - With no reactive power consumption
  - With LVRT Protection

Key Tech Parameters of Project

Installed Capacity	: 2x10 MW
Turbine Type	: 800 kW (Gamesa AE-59)
Generator	: Synchronous
Hub height	: 60 m
Rotor diameter	: 59 m
Power Regulation	: 100% variable speed
No. of Turbines	: 25
Average Wind Speed	: 6.9 m/s (At 60m)
Air Density	: 1.158kg/m^3
Turbine Spacing	: 133 m in a single raw
Expected Plant Factor	: 30% with 90% Plant Avlty
Total yield	: 52.56 GWh per annum

3b. Turbine

- Type of warranty offered
  - 2 years comprehensive warranty
- Long-term Maintenance contract
  - 3 years comprehensive O&M contract after warranty period without crane

4a. Financial Model of Wind Project

- Tariff : Developer has two options either to select a three-tier tariff or flat tariff of LKR 23 / kWh. **We selected 3-Tier Tariff**

Year of operation		1	2	3	4	5	6	7	8
Wind	Non-escalable	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53
	Escalated O&M	2.46	2.64	2.84	3.05	3.28	3.52	3.78	4.06
	Total	**24.99**	**25.17**	**25.37**	**25.58**	**25.81**	**26.05**	**26.31**	**26.59**

9	10	11	12	13	14	15
8.19	8.19	8.19	8.19	8.19	8.19	8.19
4.36	4.69	5.04	5.41	5.81	6.24	6.71
12.55	**12.88**	**13.23**	**13.60**	**14.00**	**14.43**	**14.90**

16	17	18	19	20
3.35	3.51	3.68	3.87	4.06
7.21	7.74	8.32	8.94	9.60
10.55	**11.25**	**12.00**	**12.80**	**13.66**

- Now the tariff has reduced. Flat tariff is LKR 19.43 / kWh

4a. Financial Model of Wind Project

- **Incentives**
  - 6 years income tax holiday and 15% flat there after
  - Importation of plant & machinery on duty free basis with a 5% tax

- **CDM**
  - struggling for the last two years for validation

4a. Financial Model of Wind Project

1 USD = 115 LKR ; 1 Euro = 160 LKR

	Project Cost Items	Estimated	Contracted Project Costs		
		Rs. Mill.	in Euros	in Eqnt Rs. Mill	% Change
1	Project and Site Development & land Acquisition	39		42	
2	Foundations, internal roads and Civil Structures	319		312	98%
3	Turbines, Generators and Control Equipment to Gen. Terminals including commissioning Painiting of Two Towers with RED & WHITE	2,430	14,000,000 10,000	2,242	92%
4	Freight & Insurance from Chennai Port to Colombo	150	$1,230,000	142	95%
5	Local Transport from Colombo port to Site	100	$850,000	98	98%
6	Electrical System 31.5 MVA, 33/132kV GSS	206		287 170	140%
7	Erection of electromechanical equipment including control system	124	825,000	120	96%
8	Finance and Legal Costs	2		10	434%
9	Working Capital	5		5	
10	Duties and Taxes	216		244	113%
	VAT (only for local works)	78	82		
	PAL + **NBT**	137	162		
11	Insurance	20		14	70%
12	LC & Other Bank Charges	42		32	
13	Debit Tax	6		3	
14	Project Management Expenses	38		36	
15	Contingency	200		185	
16	Spare Parts	112	700,000	112	
	Project Cost	**4,009**		**4,054**	101%

4a. Financial Model of Wind Project

Operational Costs per annum

- Administrative costs : LKR 30 M
- Scheduled maintenance cost : LKR 70 M
- Unscheduled maintenance cost : LKR 15 M
- Insurance cost : LKR 4 M
- Others: LKR 5 M
- Overall operational cost: LKR 2.40/kWh

Present Currency rates : 1 USD = 130 LKR; 1 Euro = 170 LKR

4b. Financial Model of Wind Project

Structure of project

- % Debt : 40%
- Terms of debt : 5 years
- Source of debt : HSBC
- Owners of Equity :

  Sri Lankan

- Metrics of project
  - IRR : 24%
  - Payback period : 4 years
  - Debt service coverage ratio : 1.8
- Key factors important to financiers
  - Achieving the targeted PLF

5a. Project Sitting Issues and Contracts

- Land Acquisition Issues : **approvals from 24 agencies**
- Birds/Bats/Wild life Issues : **None**
- Noise : **No issue**
- Airspace obstruction : **No**
- Telecommunications interference : **None**
- Visual Effect : **No**
- Managing neighbors : **skillful task**
- Constructability issues : **manageable**

Approvals Obtained

No.	Approving Body	Approval Type	Date Approved
01.	Sri Lanka Sustainable Energy Authority (SEA)	Provisional approval	23rd Oct 2008
02.	Letter of Intent from Ceylon Electricity Board (CEB)	LOI	10th Nov 2008
03.	Board of Investment (BOI) – Approval - Agreement signing	Tax exemptions	08th Dec 2008 13th August 2009
04.	Provincial Environmental Authority (NWP)	Environmental Clearance	18th March 2009
05.	Coast Conservation Department	Project Clearance	18th March 2009
06.	Public Utilities Commission of Sri Lanka (PUCSL)	Generation License	21st May 2009
07.	Puttalam Pradeshiya Sabha	Construction Clearance	13th July 2009
08.	Survey Plans by Sri Lanka Survey Department	Land lease clearance	30th July 2009
09.	Forest Department	Land lease clearance	10th August 2009
10.	Civil Aviation Authority of Sri Lanka	Air Clearance	13th August 2009
11.	Wildlife Department	Land lease clearance	20th August 2009
12.	Irrigation Department	Land lease clearance	25th August 2009
13.	Agrarian Services Department	Land lease clearance	27th August 2009
14.	Archaeological Department	Land lease clearance	28th August 2009
15.	Sri Lanka Sustainable Energy Authority (SEA)	Energy Permit	01st September 2009
16.	District Land Using Committee	Land lease clearance	08th September 2009
17.	**Signing Standard Power Purchase Agreement with CEB**	**For sale of electricity**	**09th September 2009**
18.	Divisional Secretariat, Puttalam	Land lease clearance	10th September 2009
19.	Urban Development Authority	Clearance	18th September 2009
20.	Provincial Land Commissioner	Land lease clearance	22nd September 2009
21.	Provincial Chief Minister	Land lease	23rd September 2009
22.	Puttalam Pradeshiya Sabha	Industrial Zone	29th October 2009
23.	Provincial Environmental Authority (NWP)	Bird Study	05th November 2009
24.	Ministry of Defence, Public Security, Law & Order	Clearance	17th November 2009

5b. Project Sitting Issues and Contracts

- EPC contractor selection
  - By WTG supplier
- Contract with utility:
  - SPPA for 20 years
  - This is a bankable doc
  - No payment default
- What was in scope: development up to 31.5MVA, 33/132kV GSS
- Interconnection issues : initially connected at 33kV level.
  - AVR malfunctioning
  - 286 shut downs within an year due to busbar failures.

6a. Pictures of the project

Mobilized to site on 29th Aug 2009

Internal Access Road works

Main Access Road works

Foundation work – Sheet piling

Excavation

Anchor Placing

Reinforcement Work

Concreting

Foundation ready for turbine erection

Erection of Bottom piece of the tower

Erection of Top piece of the tower

Erection of Nacelle

Erection of Hub with Blades

Project Execution Plan

- SPPA signed with CEB on 09.09.2009
- Foundation works from Sept'09 to May'10
- The first two (02) WTG's arrived in SL Jan'10
- Thereafter Six (06) units per month up to April'10
- Turbine Erection from Feb'10 to June'10
- Commissioning of first 10MW by 28th May'10
- Commissioning of the second 10MW by 20th July'10

Project completion in less than 10 months from SPPA signing

View of the complete Wind Farm

6b. Planed vs Actual Plant Performance 10MW Seg wind plant

Year	Month	Generation (kWh)		Plant Factor		Income (LKR)	
		Estimated	Actual	Estimated	Actual	Estimated	Actual
2011	January	826,112	1,147,238	12%	16%	20,793,232	28,864,508
	February	582,139	891,951	9%	14%	14,652,451	22,441,487
	March	705,880	700,490	10%	10%	17,767,010	17,624,328
	April	493,068	667,613	7%	10%	12,410,525	16,797,143
	May	3,745,274	3,432,552	52%	48%	94,268,545	86,363,008
	June	3,345,388	4,655,320	48%	67%	84,203,406	117,127,851
	July	4,040,088	4,465,948	57%	63%	101,689,027	112,363,252
	August	3,911,230	4,429,361	55%	62%	98,445,666	111,442,723
	September	3,659,188	4,406,387	53%	64%	92,101,756	110,864,697
	October	2,046,888	1,438,662	29%	20%	51,520,163	36,196,736
	November	731,158	519,741	11%	7%	18,403,257	13,076,684
	December	946,932	937,861	13%	13%	23,834,276	23,596,583
	TOTAL	**25,033,346**	**27,693,124**	**30%**	**32.9%**	**630,089,314**	**696,759,000**

6c. What was fun and rewarding?

- We are proud of developing so far largest first commercial scale wind farm in Sri Lanka

- It was fun transporting the longest single piece with many challenges through 120km

- The Project received Presidential award -2010 for "**Outstanding Leadership in Introducing Technology**"

Receiving the Presidential Award

6d. What was frustrating?

- The main frustration was in getting so many approvals

- Have to face many hindrances when developing a NCRE project. A strong oil lobby.

6e. Wish List to Accelerate Wind Development

What the Government has done?

- The private sector proved that wind power generation is a commercially viable energy generation mechanism
- Since last few months another 40MW's of Wind Plants are ready to be connected to the National Grid
- No grid connection available yet for this 40MW's
- The investors of these projects have incurred massive financial losses.

6e. Wish List to Accelerate Wind Development

What the Government has done?

- On top of that the government have stopped issuing licenses for private sector
- They have decided to develop a 100MW large scale wind farm on their own
- The decision was taken in June 2011
- One year has lapsed. Nothing much has happened to date ???
- The country is losing on a natural resource available in abundance.

6e. Wish List to Accelerate Wind Development

What the industry & others can do?

- The private sector is capable of Investing & developing even 300MW's within the next 5 years
- We only need proper policies in place
- Also our grid is a small system with 2100MW of peak demand
- We will need advanced technological study support from organizations such as ADB on integration of more wind power into our system


Thank you
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