Welcome to WindTalks Namibia

Monday, November 7
Windhoek, Namibia
Welcome – Agenda for Introductory Session

Master of Ceremonies:
Mr. Donovan Weimers, Director, Institutional Development and Fundraising, Polytechnic of Namibia

08:30 Welcome
Dr. Tjama Tjivikua, Rector, Polytechnic of Namibia
Mr. Hans Vestergaard, Senior Vice President of Vestas Sales

08:45 The UNDP Dialogue Development Forum™ Series
Mr. Neil Boyer, Deputy President Representative, UNDP

08:55 Discussion – Agenda Review and Expectations
Mr. Kudakwashe Ndhlukula, Coordinator at REEEI, Polytechnic of Namibia

09:00 Official Opening Remarks
Hon. Isak Katali, Minister of Mines & Energy

09:15 Why wind energy in Namibia?
Mr. Hans Vestergaard, Senior Vice President of Vestas Sales

09:30 Coffee break

09:45 Case Study - Lake Turkana Wind Power Project
Mr. Carlo van Wageningen, Chairman of Lake Turkana Wind Power
Dr. Tjama Tjivikua,
Rector, Polytechnic of Namibia
Welcome

Mr. Hans Vestergaard,
Senior Vice President of Sales for Vestas Central Europe
Mr. Neil Boyer,
Deputy President Representative, UNDP
Discussion – Agenda Review and Expectations

Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia
Session 1:
Political/Regulatory Framework for Wind Energy

10:15
Regulatory status and roadmap for wind energy in Namibia
Mr. Rojas Manyame,
GM Technical Regulation, ECB

10:45
Lessons learnt from other countries
Mr. Malte Meyer,
Director of Vestas Government Relations

11.15
Discussion – Political next steps
Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia

11:45   Coffee Break
Session 2: Grid integration of wind energy

12:00
Grid situation in Namibia
Mr. Paulinus Shilamba, Managing Director of NamPower

12:15
International best practices
Mr. Erik K. Soerensen, Director, Grid Expert at Vestas

12:45
Wind integration in Namibia
Mr. Erik K. Soerensen, Grid Expert at Vestas

13:15
Discussion – Grid Integration next steps
Mr. Kudakwashe Ndhlukula, Coordinator at REEEI, Polytechnic of Namibia

13:30 Lunch
Session 3:  
**Finding a feasible financial model**

14:00  
**Project economics in Namibia**  
Mr. Phylip Leferink, Vice President of Sales, Vestas

14:30  
**Overview of financing instruments to improve bankability**  
Mr. Stuart Smith, Director of Vestas Structured Finance

15:00  
**Practical challenges in securing financing for a wind project**  
Mr. Carlo van Wageningen, Chairman of Lake Turkana Wind Power

15:30  
**Discussion – Financing next steps**  
Mr. Kudakwashe Ndhlukula, Polytechnic of Namibia

16:00  
Coffee break
Wrap-up Session: Connecting the dots

16:15
Summary: Steps towards the first wind farm project
Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia

16:30
Way forward: next steps and future cooperation
Mr. Hans Vestergaard,
Senior Vice President of Vestas Sales

17:00
End of official program & Cocktail

18:00
Dinner
Official Opening Remarks

Hon. Minister Isak Katali
Minister of Mines & Energy
Why Wind Energy in Namibia?

Hans Vestergaard
Senior Vice President of Sales
Vestas Central Europe
Who are we? Vestas

Global leader in wind energy

6.9 billion
Euro revenues in 2010

22,000
Employees

Activities in 67 countries

>43,000
installed turbines

Wind, Oil and Gas expresses the ambition of making wind an energy source on a par with fossil fuels.

12%
share of world deliveries 2010

25%
share of all installed capacity

95 billion kWh
clean energy per year

A focus on technology and innovation through the industry’s largest Technology R&D Centre, data collection and wind and siting capabilities...
Wind Energy is working in Africa

Vestas has been active in Africa for more than ten years

- **Morocco**: 84 turbines, 50 MW
- **Cape Verde**: 28 MW
- **Egypt**: 124 turbines, 79 MW
- **Kenya**: 6 turbines, 5.1 MW
- **Mauritius**: 1 turbine, 0.1 MW

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Vestas in Southern Africa

- Local activities for ten years in Johannesburg
- Office opened in 2010
- Very active in development of the African wind industry.
Africa needs Energy ...

...to support its fast growth!

According to the World Bank, 30 countries in sub-Saharan Africa face an energy crisis and inadequate access to energy. This is among the region’s biggest impediment to economic growth...
Why is wind power part of the solution for Namibia’s growing demand for energy?
Namibia has wind

Namibia is blessed with excellent natural resources for the use of wind energy.

Sources: Vortex; Vestas Wind & Site (2011)
Wind can bring economic benefits to Namibia

- Creation of skilled jobs
- Free Fuel
- Price Stability
- Comparable low cost of energy
Wind Energy creates good jobs

<table>
<thead>
<tr>
<th>Industry</th>
<th>Wind</th>
<th>Coal</th>
<th>Gas</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobs/MW</td>
<td>2.79</td>
<td>1.01</td>
<td>0.95</td>
<td>2.18-2.34</td>
</tr>
</tbody>
</table>

The higher the volume of wind energy, the more it makes sense to source locally as you move up the value chain
Wind is predictable: No price fluctuation, but forecasting fossil fuel prices is very difficult.

...therefore, depending on imported fuel brings price and currency fluctuation risks

Note: Solid lines on the left chart are spot WTI oil prices, on the right chart are WEO average of WTI. The Dashed lines are price projections

Wind is cost-competitive

Apart from Geothermal*, wind energy is the most competitive in terms of Cost-of-Energy amongst renewable energy sources.

**Q3 2009 Levelised Cost of Energy: $US/MWh**

*Geothermal* requires long lead times for exploration & installation and lacks sufficient sites

Source: Bloomberg, New Energy Finance, 2009
Wind is fast:  
A superior ramp-up time compared to other energy sources

With 2-5 years per site, wind has the shortest ramp-up time of any renewable source:

<table>
<thead>
<tr>
<th>Source</th>
<th># of Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>2-5</td>
</tr>
<tr>
<td>Solar</td>
<td>3-6</td>
</tr>
<tr>
<td>Hydro</td>
<td>6-8</td>
</tr>
<tr>
<td>Geothermal</td>
<td>5-9</td>
</tr>
<tr>
<td>Biomass</td>
<td>5-9</td>
</tr>
<tr>
<td>Nuclear</td>
<td>10-12</td>
</tr>
</tbody>
</table>

4 months were enough to construct the Vestas V90-1.8 MW turbine in Coega

Wind is dry: Water scarcity is one of the greatest challenges facing Namibia

Wind power consumes no water – which is in short supply in many African countries, including Namibia.

Average water consumed (litres/MWh)

- **Wind**
- **Coal (dry-cooled)**
- **Solar PV**
- **Natural Gas**
- **Coal (wet-cooled)**
- **Nuclear**
- **Solar CSP**
- **Oil**

Photo from: https://www.indiatimes.com/images/water-scarcity390810.jpg
Recent examples of water constraints in power production – Africa

- **Burkina Faso, 2008-09** – Heatwave reduces efficiency of thermoelectric power generation
- **Côte d'Ivoire, 2006** – Drought reduces hydropower generation and ultimately to electricity price increase
- **Ghana, 2007** – Drought reduces hydropower generation and causes power outages
- **Togo, 2006-07** – Diminished hydropower generation due to drought
- **Benin, 2006-07** – Diminished hydropower generation due to drought
- **Cameroon, 2007** – Drought causes blackouts and contributes to strikes
- **Rwanda, 2005** – Reduced hydropower production leads to electricity price increase
- **Ethiopia, 2008-09** – Drought reduces hydropower generation and causes power outages
- **Kenya, 2000-11** – Drought reduces hydropower generation and causes power outages
- **Kenya, 2006, 2009-10** – Reduced hydropower production leads to electricity price increase
- **Uganda, 2005-06** – Drought reduces hydropower generation and causes power outages
- **Uganda, 2006, 2010** – Reduced hydropower production leads to electricity price increase
- **Tanzania, 2006** – Reduced hydropower production leads to electricity price increase
- **Tanzania, 2006, 2010, 2011** – Drought reduces hydropower generation and causes power outages

- Water-related reduction in power output / power cuts
- Water-related power price increases
- Power plants with legal challenges due to water issues
- Power plants with public opposition due to impacts on water resources and aquatic species

[CH2M Hill/Vestas, non-exhaustive press survey 2005-2011]
Wind can support Namibia’s sustainable development...

Wind is the lowest greenhouse gas (GHG) emissions energy source over its lifecycle.

![Graph showing carbon-based energy forms and non-wind renewables emissions](source: Singapore IEW Conference Key Takeaways, November 2009)
Mr. Hans Vestergaard,
Senior Vice President of Sales for Vestas Central Europe

Thank you
Coffee Break

We will resume in 15 minutes
Issue Sessions

Moderator:
Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia
Case Study: the Lake Turkana Wind Power project

Mr. Carlo van Wageningen
Chairman of Lake Turkana Wind Power
Agenda

1. How did it all start?
2. A unique wind resource
3. The logistic challenge
4. By whom and how is the project Financed?
5. Where are we?
The project’s history dates back to 2004...

One of the founding members of lake Turkana Wind Power (LTWP) had known about the site for years....

2004
Anset Africa approached to look at developing a wind power project on that site

June 2005
KP&P of Netherlands was approached to come and visit the site.

2005
Oil prices soared to above $US 45/barrel, rendering wind power competitive in Kenya.

September 2005
1st MOU signed between Anset Africa and KP&P – the beginning of the development of this challenging project.

Now??
Where in Kenya are we located?
1. How did it all start?

2. A unique wind resource

3. The logistic challenge

4. By whom and how is the project Financed?

5. Where are we?
We have an unparalleled and unique wind resource...

- Favourable location: Lies in the “Turkana Corridor”, a low-level jet stream from the Indian Ocean creates strong and predictable winds
- Aided by the presence of Mount Kulal to the North and Mount Nyiru to the South, which act to produce a Venturi effect – accelerating the winds across the project site.

**Equipment:** 365 V-52 850kW wind turbines, carefully sited to optimize energy production
Stable winds – all day

Estimated wind power output based on wind measurement for May 1, 2010

Wind Distribution April, 2010

Wind Speed (m/s)

Day of the month
1. How did it all start?

2. A unique wind resource

3. The logistic challenge

4. By whom and how is the project Financed?

5. Where are we?
The logistical challenges . . .

- The site is 1,200km from the nearest deep-sea port (Mombasa)
- The nearest Grid Interconnect Point was 428km from the site
- Upgrading of 206 km of Road
- Construction of 3 flood bridges
- Use of 6 wheel drive trucks from Laisamis to site
- Most demanding parts: 3 transformers 80 tonnes each, measuring 5m x 4m x 4m
- 1,200 truck-loads
And solutions for the logistical challenges

4 Road surveys . . .

. . . by 3 transport and logistic companies

• Mammoet
• SDV Transami
• Civicon

. . . and by Vestas
Grid connection

400 kV T. line from the project site to Suswa – 428km.

International procurement process:

- Task Force – MOE, KPLC, KETRACO, KEMA, KPMG, LTWP
- Public Sector Implementation.
- Contract awarded to ISOLUX Corsan. (Spain).
- Contract negotiations completed on 25.2.2011
- Execution period 22 months.
- Cost Euro 142.5M of which 110M from Spain and balance from the Kenyan government
1. How did it all start?

2. A unique wind resource

3. The logistic challenge

4. By whom and how is the project Financed?

5. Where are we?
How is the project financed?

Total Project Cost: 617 M Euro (Wind Farm + Balance of Plant only)

Debt/Equity Ratio: 70% Debt (432M) – 30% Equity (185M)

Debt Lead Arranger: African Development Bank (AfDB)
Co-Arrangers: STANDARD BANK & NEDBANK
Power Purchase Agreement details

Power sold to Kenya Power and Light Corporation

PPA terms:
- fixed price (20 years): 7.52 Euro cents per kWh
- Escalation only on O&M part of the costs
- Take or pay
- 20 years term after full commissioning

Status:
SIGNED on 29th January 2010 and restated on 30th September 2011

Carbon Credits: Approx. 780,000 CER’s/y of which the 1st US Cent/KW/hr returned to Kenya.
The project has an extensive corporate social responsibility component

Well designed Corporate Social Responsibility programme over 20 years, implemented in 4 x 5-year development plans

Focusing on:
• Water
• Health and sanitation
• Education
• Electrification

Carbon Credits: Up to US$ 16.5 Million/year to be devoted to the development of the areas surrounding the project site and along the transmission line route
1. How did it all start?

2. A unique wind resource

3. The logistic challenge

4. By whom and how is the project Financed?

5. Where are we?
Where are we now?

Current Status

- All EPC Contracts completed and initialled.
- PPA in place.
- IPP license in place.
- Multilateral Investment Guarantee Agency (MIGA) and International Development Association guarantees, applications in process.

- Transmission of final Project Information Memorandum and all documentation to Lenders completed on 10th August 2011
- By mid-November lenders Term Sheet expected
- Financial Close expected by 31st March 2012
- Ground-breaking expected in April 2012
Mr. Carlo van Wageningen, Chairman of Lake Turkana Wind Power

Thank you

We take this opportunity to extend our gratitude to the Government of Kenya, KPLC, ERC. and KETRACO for the unwavering support and faith they have extended to this challenging project.

It is our sincere hope that other African Governments will want to follow in Kenya’s footsteps as this is a perfect example of a successful Public-Private-Partnership that can pave the way for further large foreign direct investment opportunities in the region.
Session 1: Political/Regulatory Framework for Wind Energy

10:15
Regulatory status and roadmap for wind energy in Namibia
Mr. Rojas Manyame,
GM Regulation, ECB

11:00
Lessons learnt from other countries
Mr. Malte Meyer,
Director of Vestas Government Relations

11.30
Discussion – Political next steps
Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia

12:00 Coffee Break
Regulatory status and roadmap for wind energy in Namibia

Mr. Rojas Manyame
ECB, General Manager: Regulation
Regulatory Status and Road Map for Wind Energy in Namibia

R Manyame
General Manager: Regulation
CONTENTS

* ECB Mandate
* ECB Functions
* Licensing
* RE Procurement Mechanisms
* Policy on Tariffs
* Support Projects for IPPs
  * Grid Code
  * IPP and Investment market Framework
  * RE Procurement Mechanisms
  * NIRP
* Challenges
* Conclusion
ECB Mandate

- Derived from the Electricity Act (Act 4 of 2007)
- 5 Main Objectives
  - To exercise control over and regulate the provision, use and consumption of electricity in Namibia;
  - To oversee the efficient functioning and development of the electricity industry and security of electricity provision;
  - To ensure the efficient provision of electricity;
  - To ensure a competitive environment in the electricity industry in Namibia
  - To promote private sector investment in the electricity industry
Determining the **economic conditions** of supply
* by way of suitable tariff regimes:

Determining the **technical conditions** of supply
* by means of standards, regulations and rules:

* **Managing licenses** for suppliers in the ESI
  * by means of issuing, transfer, amendment, renewal, suspension and/or cancellation:
  * and the approval of the conditions on which electricity may be provided by a licensee;

* **Verifying adherence** to license conditions
  * by means of regular monitoring, evaluation and feedback:
ECB Functions..

- **Advising the Minister** on ESI matters
  - by means of recommendations on various issues
    - license issues

- **Mediation**
  - Between licensees
  - Between licensees and their customers/prospective customers
  - On matters including installation and functioning of meters, suitability of equipment and delays or refusal to supply

- **Understanding the industry,**
  - stakeholders and their needs through regular consultations and investigations:
Licensing Procedures

1. Receipt of Application
2. Recording in Register and File
3. Application Meets Requirements
   - YES: 5. Commencement of Formal Evaluation Process
   - NO: 4. Notify Applicant and Ensure Compliance
4. Notify Applicant and Ensure Compliance
   - NO: 3. Application Meets Requirements
   - YES: 6. Reasonable Objections Received
5. Commencement of Formal Evaluation Process
6. Reasonable Objections Received
   - YES: 7. Conduct Public Hearing
   - NO: 3. Application Meets Requirements
7. Conduct Public Hearing
   - NO: 6. Reasonable Objections Received
   - YES: 8. Approval granted by Secretariat
8. Approval granted by Secretariat
   - NO: 7. Conduct Public Hearing
   - YES: 9. Amendment by Secretariat
9. Amendment by Secretariat
   - NO: 8. Approval granted by Secretariat
   - YES: 10. Submission by Board to Minister
10. Submission by Board to Minister
   - NO: 9. Amendment by Secretariat
   - YES: 11. Approval of License granted
11. Approval of License granted
   - NO: 8. Approval granted by Secretariat
   - YES: 12. ECB to inform applicant in writing
Current RE Procurement Mechanism

- Project developer approaches the ECB with project motivation
- ECB evaluates and issues conditional licenses
- Now moving towards bidding process for large projects
- Study done on procurement mechanism
- Outcomes support tendering for large projects
- Outcomes approved by the Board
Government Policy states that tariffs should be:

- Be cost reflective
- Be Based on sound economic principles
- Create a level playing field for all ESI participants
- Reflect long Run Marginal Cost

Generation Tariff Methodology Developed
- Cost Plus

Cabinet decided that bulk tariffs should be cost reflective in 2011/2012.
<table>
<thead>
<tr>
<th>Licensee</th>
<th>Fuel Type</th>
<th>Date Issued</th>
<th>Plant Size (MW)</th>
<th>License Period (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeolus Power Generation</td>
<td>Wind</td>
<td>01-04-07</td>
<td>92</td>
<td>22</td>
</tr>
<tr>
<td>BINVIS/ Atlantic Energy Coast</td>
<td>Coal</td>
<td>01-11-07</td>
<td>700</td>
<td>25</td>
</tr>
<tr>
<td>Bush Energy Namibia (CBEND)</td>
<td>Solid Biomass</td>
<td>01-05-10</td>
<td>0.250</td>
<td>5</td>
</tr>
<tr>
<td>Electrawinds</td>
<td>Wind</td>
<td>01-11-09</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Innowind</td>
<td>Wind</td>
<td>01-03-10</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>Namibia International Mining Co. (NIMC)</td>
<td>Diesel /CCGT</td>
<td>01-06-07</td>
<td>210 (68)</td>
<td>20</td>
</tr>
<tr>
<td>Vizion Energy Resources</td>
<td>Coal</td>
<td>13-03-08</td>
<td>800 (400)</td>
<td>25</td>
</tr>
<tr>
<td>VTB Capital</td>
<td>Hydro</td>
<td>15-07-07</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>GreeNam</td>
<td>Solar</td>
<td></td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

CCGT stands for Combined Cycle Gas Turbine (Technology)
## Wind Licenses Issued to Date

<table>
<thead>
<tr>
<th>Licensee</th>
<th>Type</th>
<th>Size</th>
<th>Date Issued</th>
<th>Validity period (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diaz Wind Power (Pty) Ltd</td>
<td>Wind</td>
<td>44 MW</td>
<td>1-Apr-07</td>
<td>22</td>
</tr>
<tr>
<td>Electrawinds (Pty) Ltd</td>
<td>Wind</td>
<td>50 MW</td>
<td>1-Nov-09</td>
<td>20</td>
</tr>
<tr>
<td>Innowind (Pty) Ltd</td>
<td>Wind</td>
<td>60 MW</td>
<td>1-Mar-10</td>
<td>20</td>
</tr>
</tbody>
</table>
IPP Support Projects

* Grid Code
* IPP and Investment Market Framework
* RE Procurement Mechanisms
* NIRP
Project aim was to develop an RE procurement mechanism for Namibia

Outcomes
- REFIT for landfill, small hydro, small wind and biomass (less than 5MW)
- Tendering for large wind power plants and CSP facilities
- Net metering for PV
- Supporting measures like soft loans, tax incentives, etc.
- ECB Board Approval done
- Implementation Phase
Grid Code

* Deal with Access issues
* Five Parts
  * Network
  * System Operations
  * Metering
  * Governance
  * Information Exchange
* Will include a Wind Code
IPP and Investment Market Framework

* Study commissioned to find ways of attracting IPPs
* Aimed at Creating a conducive environment for IPPs
* Completed in 2008
* On ECB Website
**NIRP Objectives**

- Reduction in the vulnerability of electricity supply to disruptions in supply caused by events outside of the country;
- Increase in diversification, security, reliability and efficiency of electricity supply, including the substitution of electricity by other energy sources such as oil, gas, biofuels and solar in order to improve efficiency;
- Development and implementation of the demand side management measures and programs;
- Minimization of costs and negative environmental and social impacts of electricity supply;
- Increase in use of local resources for generation of electricity;
- Provision of social benefits through increased economic growth, rural electrification and employment;
- Increase the use of local resources to provide electricity services.
NIRP Tasks

* Development of Economic and Cost Assumptions
* Development of a Demand Forecast
* Definition and Evaluation of Generation Options, Import Sources and Demand Management Options
* Development and Analysis of Policy Implementation Scenarios
* Conclusions and Documentation of the Outcome and Results
Funded by MME and World Bank
Hatch is the Consultant
Steering Committee is driving the Project
1st Meeting held in August 2011
Next meeting is in December 2011
Workshop will be held thereafter in February 2012
Project to be concluded in July 2012
Challenges

* Absence of specific RE policy
  * RE included in White Paper on Energy Policy
* Lack of enabling RE Framework
* Procurement mechanism refinement
* Introduction of special instruments to ensure a greater share of RET in the electricity supply (like quotas, REFIT and others).
Conclusion

- Namibia has abundant RE resources
- Need to set up mechanisms for exploiting these resources
- Need to develop specific RE policy
- Need for Robust RE Framework
- Minister to proclaim regulations to govern the renewable energy resources procurement (empowered by Section 43 of Electricity Act of 2007)
- NEF to support RE uptake to mitigate tariff impact
Thank You
Political/Regulatory Framework for Wind Energy: Lessons Learnt from Other Countries

Malte Meyer
Director, Government Relations
Vestas Central Europe
1. Government Support

2. PPA Structuring
As first steps to kick-start wind energy, Governments are well advised to . . .

- Offer a suitable procurement mechanism
- Provide assurance that wind tariff costs will be covered
- Set renewable energy targets
## Procurement Mechanisms: Tenders or REFITs suit larger volumes, but single project PPAs can be fast and low risk option for Namibia

<table>
<thead>
<tr>
<th>Policy tool</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Implementation</th>
<th>Recommended for Namibia?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quota/Certificates</td>
<td>• Market image</td>
<td>• High costs, windfall profits • Favors larger players</td>
<td>Lengthy</td>
<td>Low</td>
</tr>
<tr>
<td>Tender</td>
<td>• Cost competition - price transparency • Implicit cap (control over capacity addition)</td>
<td>• Risk of project failures • More efficient with larger volumes • Stop-and-go market risk</td>
<td>Lengthy</td>
<td>Medium-High*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* for larger market Volumes</td>
</tr>
<tr>
<td>REFIT</td>
<td>• Mobilizes small or community IPPs • Stable market volume better for industry development</td>
<td>• Complex cost monitoring</td>
<td>Lengthy</td>
<td>High</td>
</tr>
<tr>
<td>Capital grants</td>
<td>• Direct CAPEX support lowers marginal costs</td>
<td>• Power market / merit order distortion</td>
<td>Fast</td>
<td>Medium</td>
</tr>
<tr>
<td>PPA (single projects)</td>
<td>• Limited overall cost exposure • Reference projects</td>
<td>• Tariff / risk sharing negotiations can be difficult</td>
<td>Fast</td>
<td>High</td>
</tr>
</tbody>
</table>

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*Wind. It means the world to us.*
Procurement Mechanisms: REFITs are most wide-spread and can be very low-cost

Wind energy tariffs over 20 years by country (€/MWh)
Source: BNEF
An expected strong increase in wholesale power prices in Namibia will reduce the need for wind support costs.

"The average wholesale power supply tariff will more than double by 2016."

Honorable Minister Isak Katali

Assumptions: Wholesale price 100 ct/kWh (2016); thereafter 5% growth p.a.; total national consumption 3.6 bn kWh, grows at wholesale price rate.
Setting clear and binding renewable/wind energy targets will motivate and guide the market

Renewable Electricity Shares

• Can be Renewable Portfolio Standard (RPS) imposed on utilities
• Often binding, with penalties

MW build-out targets

• Often only guidance, but combined with effective REFIT etc
• Can be precisely achieved when combined with tenders
• Based on demand-supply forecast/planning (NIRP)

<table>
<thead>
<tr>
<th>Country</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>10% by 2020</td>
</tr>
<tr>
<td>Cameroon</td>
<td>50% by 2015</td>
</tr>
<tr>
<td>Cape Verde</td>
<td>50% by 2020</td>
</tr>
<tr>
<td>Egypt</td>
<td>20% by 2020</td>
</tr>
<tr>
<td>Ghana</td>
<td>10% by 2020</td>
</tr>
<tr>
<td>Morocco</td>
<td>20% by 2012</td>
</tr>
<tr>
<td>Nigeria</td>
<td>7% by 2025</td>
</tr>
<tr>
<td>South Africa</td>
<td>13% by 2020</td>
</tr>
</tbody>
</table>

Government Support Tools - Conclusion

- Clear political signals are instrumental

- As a fast first step, Governments can create reference projects with single project PPAs

- Differential costs should be spread over all consumers, but impact of wind power is minimal
PPA Structuring - Conclusions

- First developers need guidance on planning conditions through Government agreement
- Long-term PPAs on must-take electricity best option
- Escrow accounts can reduce direct exposure if Government guarantees PPA
Mr. Malte Meyer
Director of Government Relations, Vestas Central Europe

Thank you
Discussion – Political next steps

Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia
Lunch break

We will resume in 30 minutes
Session 2: Grid integration of wind energy

12:30
Grid situation in Namibia
Mr. Paulinus Shilamba, Managing Director of NamPower

12:45
International best practices
Mr. Erik K. Soerensen, Director, Grid Expert at Vestas

13:30
Wind integration in Namibia
Mr. Erik K. Soerensen, Grid Expert at Vestas

14:00
Discussion – Grid Integration next steps
Mr. Kudakwashe Ndhlukula, Coordinator at REEEI, Polytechnic of Namibia
Session 2: Grid integration of wind energy

Grid situation in Namibia

Mr. Paulinus Shilamba,
Managing Director of NamPower

NamPower
WIND TALKS NAMIBIA

Grid Situation in Namibia
P.I. Shilamba
Managing Director
7 November 2011, Windhoek
Introduction

- Presentation on the Energy and Grid Situation in Namibia
- Sharing of Information on:
  - Power Supply Situation
  - NamPower Grid and its Challenges
  - Issues with regards to Grid Integration of Wind Energy
Demand Situation in Namibia

- **2011 Maximum Demand Registered (5 July 2011)**
  - 511.482MW excluding Skorpion Mine
  - 593.812MW including Skorpion Mine

- **Load Forecast**
  - Latest August 2011
Power Generation in Namibia

<table>
<thead>
<tr>
<th>Power Plant</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruacana</td>
<td>249</td>
</tr>
<tr>
<td>Van Eck</td>
<td>120</td>
</tr>
<tr>
<td>Paratus</td>
<td>24</td>
</tr>
<tr>
<td>Anixas</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>2009</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>40%</td>
<td>42%</td>
</tr>
<tr>
<td>Imports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eskom</td>
<td>41%</td>
<td>53%</td>
</tr>
<tr>
<td>Others</td>
<td>19%</td>
<td>5%</td>
</tr>
</tbody>
</table>

*Eskom import down to 20% and others up to 40% in 2010*
Recent Success Stories

- Hwange Investment
  - 150MW PPA (2008 – 2013)
  - Good example of regional cooperation

- Caprivi Link Interconnector
  - 300MW transfer capacity, currently limited due to AC network constraints
  - Completed June 2010 with official commissioning on 12 November 2010 by 4 Heads of States
  - Opportunity to implement phase 2 (additional 300 MW)

- Anixas Emergency Diesel Power Station
  - 22MW capacity, operational since July 2011
  - Commissioned 3 November 2011
Current Generation Projects

- Ruacana 4th Unit
  - Installation to increase capacity with 90 MW to 330 MW
  - Project Dates:
    - Commencement date: 27 March 2009
    - Work on site commenced: July 2010
    - Commercial operation: expected March 2012
Conventional Power Generation Projects under Feasibility Study Phase

- **Kudu Gas-to-Power**
  - Approximately 800MW generating capacity
  - Final Investment Decision expected by middle 2012

- **Erongo Coal**
  - Modular units of 150MW to 300MW, extendable if required
  - Similar timing as Kudu
  - Parallel preparation with Kudu till final decision as to which project to develop first

- **Baynes Hydro Power Station**
  - 500MW mid-merit/peaking
  - Coordinated by governments of Angola and Namibia through PJTC
  - Expect commissioning by 2018
Renewable Energy Projects under Feasibility Study Phase

- **Wind**
  - Walvis Bay (±60MW)
  - Lüderitz (±44MW)
  - PPA discussions ongoing

- **Solar**
  - Large scale (3 x ±10MW)
    - PPA discussions ongoing
  - Small scale connected to grid – discussion ongoing with ECB

- **Biomass (Invader Bush)**
  - Feasibility study in progress, draft report by December 2011
  - Objective to determine logistics around feedstock
Short Term Critical Supply Project (STCS)

- Any base load power station for commissioning only by 2015/2016
- Power supply deficit of 80 MW by the 2012 winter, increasing to 300 MW by 2015.
  - Worsened by expiry of ZESA agreement in 2013
- A dedicated team appointed to the project
- Solutions will include one or a combination of the following:
  - New power purchase agreements with SAPP trading partners
  - New renewable energy projects and PPA with renewable energy IPP’s
  - Increased DSM programs
  - Upgrading of existing plants (Van Eck, Ruacana, Paratus, Anixas)
  - PPA’s with other IPP (Arandis Power)
- Final project plan expected by Dec 2011
Transmission Grid

- Interconnected to
  - Zambia (Zesco) through Caprivi Link Interconnector
  - South Africa (Eskom) through 400kV and 220kV lines

- Characteristic
  - Long radial network
  - Low fault levels
  - Near 50 Hz resonance phenomenon
Issues Pertaining to Wind Integration in Namibia - Regulatory

- NamPower support government policy on renewable energies
  - promotion of the use of renewable sources of energy
  - renewable energy to be part of the supply mix

- Challenges with integration of renewable energies
  - High cost in comparison to conventional sources
  - Absence of Namibian Grid Code on Wind Integration

- NamPower Renewable Energy Target
  - Ten percent of capacity from renewable energies
  - This target presently under review
Issues to be considered and investigated when connecting a wind farm

- Communication – control and monitoring of the wind farm
- Protection of the transmission connection – unitised protection throughout
- Voltage / reactive power control by the wind farm
- Low Voltage Ride Through Capability
- Fault level contribution
- Ramp up / ramp down gradient
- Tripping frequencies during island mode
- Harmonics – filter requirements
Conclusion

- Namibia needs a base load generation plant, Kudu or coal, by January 2016
- Opportunity exists in Namibia to generate power through wind farms and other renewable energy resources
- Wind farms and other renewable energy sources could play an important role during the interim STCS period until 2016, as they can be developed faster
- NamPower is currently revisiting its renewable energy target
- Grid code on integration of wind farms required for the successful integration of wind farms into the national transmission network
I thank you for your attention
Session 2: Grid integration of wind energy

International best practices

Mr. Erik K. Soerensen,
Grid Expert at Vestas Group Government Relations
High wind penetration levels are entirely possible
Wind Penetration Levels by end 2009
- showing wind’s share of domestic electricity consumption

Source: Wiser & Bolinger 2010
How have different countries achieved their high wind penetration shares?
In Denmark, balancing is handled via strong interconnectors and a well functioning market.

Balancing is handled via the Nordic Electricity Market.

Denmark has set a target of 50% wind penetration by 2020.
In Germany the high wind share is also handled via interconnectors and market. Geographic dispersion helps.

Germany has approx. 6% wind production onshore, and a very ambitious programme for offshore installations (25,000 MW by 2030).
Spain is essentially “an electrical island”. Balancing via the rest of the generation mix. Geographic dispersion is helpful.

Spain has had a very rapid growth in onshore wind installations. Now more than 20,700 MW in operation. By 2020 capacity is expected to be 38,000 MW. Focus on forecasting.
Other examples - Cape Verde. Small islanding systems.

Cape Verde to be entirely wind-powered

Britain is to spend £26 million building a wind farm to power the entire Cape Verde, the isolated archipelago off the west coast of Africa.

Note: islands are not interconnected – average numbers

Total power generation (2008): 257 GWh
Total power consumption (2008): 239 GWh

Total wind capacity 28 MW
Assuming 2,000 full load hours per year, wind will generate 56 GWh per year. Corresponding wind penetration is 23%
Wind integration measures
Increasing flexibility of both generation and demand is key to achieving large wind penetrations

**Minimum loads on conventional power plants**

- Example: Danish grid code requires 30% minimum load. Due to market incentives, most plants now able to stay on grid with only 10-15% load
- Both existing and new power stations
- For CHP: decouple heat constraints through heat storage
- Negative prices in spot markets (example Denmark and Germany)

**Faster dynamic characteristics for all generating units**

- Faster ramp rates (MW/min.)
- Shorter start-up times and lower start-up costs

**Creating flexibility in demand**

- Disconnectable loads on contract
- Electric heaters for district heating
- Heat pumps, small scale and large scale
New means of integrating wind power; Tools proposed by Danish TSO en route to 50% penetration

<table>
<thead>
<tr>
<th>Means</th>
<th>Short term</th>
<th>Medium term</th>
<th>Long term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary focus:</td>
<td>• Expansion of interconnections - cross-border electricity trade</td>
<td>• Geographical spread of offshore wind farms</td>
<td>• Electricity storage in hydrogen for fuel cells</td>
</tr>
<tr>
<td>Power system balancing</td>
<td>• Reinforcement and expansion of existing grid</td>
<td>• Demand response</td>
<td>• Compressed Air Energy Storage</td>
</tr>
<tr>
<td></td>
<td>• Downward regulation of production through negative spot prices</td>
<td>• Flexible electricity generation</td>
<td>• Electricity storage in batteries</td>
</tr>
<tr>
<td>Primary focus:</td>
<td>• Heat pumps in power stations</td>
<td>• Heat pumps in private households</td>
<td>• Use of (electrolysis-based) hydrogen in transport sector</td>
</tr>
<tr>
<td>Electricity integration in</td>
<td>• Electric boilers in power stations</td>
<td>• Plug-in hybrid cars</td>
<td>• Use of (electrolysis-based) hydrogen in natural gas grid</td>
</tr>
<tr>
<td>other energy sectors</td>
<td></td>
<td>• Electric cars</td>
<td></td>
</tr>
</tbody>
</table>

Source: Energinet.dk

Wind. It means the world to us.
In Spain, the independent TSO focuses on short-term forecasting of wind generation.

The Spanish Electric Power Law stipulates that wind farms must forecast their energy output and present their wind power generation plans to grid enterprises in advance. When the forecast differs from actual output by over 20%, wind farm operators must pay a penalty to the grid company. Spanish wind power development enterprises and research institutions have undertaken a large amount of research in the fields of wind resource and wind short-term power forecasting, and have achieved very high levels of prediction precision. Short-term wind energy power forecasting technology has also been applied widely throughout Spanish wind farms and power system dispatching centers.

Spain has very low capacity on international connectors, and has therefore been very focused on efficient and accurate forecasting of wind production, to be able to balance their system - at the lowest possible cost.
Importance of Wind Power Forecasting

"Fresh breeze" results in a production between 600 and 1.600 MW out of 2,400 MW!

Improved wind forecasts leads to an increased value of wind power in the market and the system

Forecast error 2007:
6% of installed capacity 24% of wind generation
Short term forecasting is an art under continual development

- Accuracy of forecasts improve when considering larger areas, “spatial smoothing”
- With large penetrations and large spreads, the forecasting errors will cancel out each other
- To the system, it is less important that the forecasted generation of the individual wind farm is accurate. What matters is accuracy of the aggregate forecast
- Aggregate forecasts must be updated continually (e.g. every 3 hours)
In addition to forecasting, it is important that installed capacity is reliable and available when the wind is blowing.

VESTAS PERFORMANCE & DIAGNOSTIC CENTER OFFERS PREVENTION THROUGH PREDICTION
Through our advanced condition monitoring solution and the world’s largest diagnostic center Vestas minimizes lost production by predicting time to failure and taking preventative actions.

Real time monitoring of 130+ SENSORS IN 16,000+ TURBINES globally

Findings are used to improve predictive models to provide RELIABLE PERFORMANCE AND YIELD MANAGEMENT.

Identify performance deviations in the fleet based on predictive models and INITIATE PREVENTATIVE MAINTENANCE.

Maintenance plans based on weather forecast to MINIMIZE LOST PRODUCTION while making repairs.
Power Plants and their characteristics determine the flexibility of the overall system

<table>
<thead>
<tr>
<th>Type</th>
<th>Operation</th>
<th>Capital Cost</th>
<th>Fuel Cost</th>
<th>Dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>Base</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Coal</td>
<td>Base</td>
<td>High</td>
<td>Low</td>
<td>Low-medium</td>
</tr>
<tr>
<td>Biomass</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Gas (CCGT)</td>
<td>Base-peak</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Hydro</td>
<td>Base-peak</td>
<td>High-low</td>
<td>Low-low</td>
<td>High-high</td>
</tr>
<tr>
<td>Diesel</td>
<td>Base-peak</td>
<td>Low-low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Wind</td>
<td>Base</td>
<td>High</td>
<td>Low-low</td>
<td>Low-high</td>
</tr>
<tr>
<td>Solar PV</td>
<td>Base</td>
<td>High</td>
<td>Low-low</td>
<td>Low-high</td>
</tr>
<tr>
<td>Interconnector</td>
<td>Base-peak</td>
<td>High-low</td>
<td>High-low</td>
<td>High</td>
</tr>
</tbody>
</table>
European Power Exchanges moving towards closer integration but bottlenecks holding back the “inner electricity marker”

Efficient coupling between market areas is still a challenge!

- European Commission has decided that market coupling across the EU must be achieved by the end of 2014
- Auctioning of scarce capacity at bottlenecks will help provide financing for reinforcements
The Overall Wind Power Challenge in Europe
- good wind location and consumption doesn’t match!

Interconnectors required to solve this!
Generation: Electricity markets in Europe facing challenges similar to Southern Africa

Nord Pool market development
- Nord Pool dominated by hydro and nuclear supply from Sweden, and Norway – at low marginal cost
- New capacity either gas, nuclear or wind power as no new hydro sites are available. Coal is not an option at the moment in Norway and Sweden
- One single power market

Nord Pool price setting from a DONG perspective
- DONG Energy is a swing producer in the Nordpool area. They only produce when electricity prices are above production costs. Prices depends heavily on precipitation
- In a normal year, only 60% of production capacity is utilized
- When prices are low, DONG can reduce production (down to the mandatory production for heat generation) and when prices are high, production will be increased

Nordpool

Accumulated production capacity - MW

Off peak demand
Peak demand

DKK/MWh

0 100 200 300 400 500 600

0 20000 40000 60000 80000 100000

Hydroelectric power Wind power Nuclear power Lignite Pit coal Gas Oil

2015 DNS
Generation: Electricity markets in Europe facing challenges similar to Southern Africa
Nordpool has four market places on a daily basis. The Intraday market is very important for wind balancing.

**Daily markets on Nordpool:**
1. Reserve market (option market)
2. Spot market (NordPool Spot)
3. Intraday market (NordPool Elbas)
4. Regulating market (real-time market - NOIS)
Measures to meet higher wind power penetration levels

- Increased transmission capacity
- Increased flexibility in generation and demand
- Efficient markets
  - use of market price signals in system control
  - congestion management
  - price elastic demand response
- Revised power system control architecture
- Detailed connection requirements (for all generators)
- Coupling between energy systems
How big are the balancing needs of wind power?

• Well sited onshore wind farms typically have 1,500 – 3,000 full load hours per year

• The corresponding capacity factors are 0.17 - 0.34

• With good geographical dispersion and good forecasting, wind’s capacity credit is in the range of 0.1 – 0.35, depending upon local factors (Europe)
How can modern wind power plants support the grid?
Planning wind development is important; below are some important elements to consider from a system perspective

**Characteristics of WindPower**

- Forecasting of production
- Power quality, stability
- Grid connection and grid codes, voltage levels
- Grid capacity and priority access
- Balancing of production

**Important Parameters**

- Wind Regime
  - Power Source
  - Turbine type, specific rotor area
  - Geographic dispersion
- How many MWs by when?
  - Defining capex for grid and wind power plant investments
- MWh produced, expected load factors
  - Defining income

**Planning, planning, planning . . .**
Power curve for Vestas V112
Annual Energy Output depends heavily on wind speeds - apologies for stating the obvious!
Grid Friendly Wind Power Plants will greatly assist the grid

• Power Plant Controller
• Load following
• Voltage Control
• Fault Ride Through
  • Low Voltage Fault Ride Through (LVRT)
Optimal utilization of all resources – including wind power. Technical requirements will prove important with increasing penetrations...

Technical and operational requirements on wind turbines leads to increased value in the market and the system.
Regulating Windpower – an real case

Windpower can contribute to system stability
Voltage/Frequency range of a grid friendly turbine

Normal: \( P = 1.0 \) p.u., \( \text{Time} = \text{continuously} \)
Area A: \( P_A = 1.0 \) p.u. \( \text{Time A} = 60 \) min
Area B: \( P_B = 0.95 \) p.u. \( \text{Time B} = 60 \) min
Area C: \( P_C = 0.90 \) p.u. \( \text{Time C} = 60 \) min
Area D: \( P_D = 1.0 \) p.u. \( \text{Time D} = 30 \) min
Fault ride through is an important grid code requirement.

**Voltage FRT-profile (WTG)**

- U (pu)
- Time (s)

The graph shows the voltage profile over time, indicating how the voltage changes in response to a fault ride through event. The specific values and time points are marked on the graph, illustrating the grid code requirement for maintaining voltage levels during such events.
Do not forget: Wind reduces power losses in the grid

• Wind is often connected at lower voltage levels closer to consumers.
• Wind power likely to change the flow direction in regional supply lines.
Wind Integration in Namibia
Namibia is an integral part of the wider SAPP. Optimisation (read: trading) across the entire market will lower cost of electricity and increase flexibility.
Namibia has sufficient balancing capacity to facilitate an immediate build-out of wind energy in the order of 100MW

Various balancing options are available to Namibia, which can unlock a substantial MW wind potential

<table>
<thead>
<tr>
<th>Balancing Measure</th>
<th>Implementation</th>
<th>Costs</th>
<th>Wind MW unlocked</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Substitution</td>
<td>Short-term</td>
<td>Save 1-3 NAD/kWh</td>
<td>=diesel capacity 45MW</td>
<td>High</td>
</tr>
<tr>
<td>Hydro</td>
<td>Short-term</td>
<td></td>
<td>=hydro storage capacity</td>
<td>Low</td>
</tr>
<tr>
<td>Complementarity RES</td>
<td>Mid-term</td>
<td>?</td>
<td>=bio/solar built-out plans</td>
<td>High</td>
</tr>
<tr>
<td>Trading – take-or-pay</td>
<td>Short-term</td>
<td>200c/kWh (TBC)</td>
<td>Contractual cap??</td>
<td>Low</td>
</tr>
<tr>
<td>Trading Spot real-time</td>
<td>Mid-long term</td>
<td>Lower?</td>
<td>Unlimited</td>
<td>High</td>
</tr>
</tbody>
</table>
Hydro balancing is an attractive mid-term alternative

Can Namibia and its neighbours increase hydro storage capacity?
Complementarity of renewables
Wind integration through geographic diversification

Namibia is blessed with excellent natural resources for the use of wind energy.

Plan for a portfolio effect with geographic spread

Sources: Vortex; Vestas Wind & Site (2011)
Shaving the noon and evening peaks with PV and wind fits neatly with system loads.

Figure 2-4: 2005 Load Curve
Fairly stable wind resource will ensure stable year-round output (illustrative example from Lüderitz)

Estimated monthly wind and temperatures along with wind frequency rose for Southern area.

Source: Vestas Wind & Site
Near-term forecasting of wind production in Namibia – some initial thoughts

At wind farm level

• Owner or his appointed representative should carry an obligation to submit day-ahead forecasts of hourly generation
• If deviations of more that 25% (?) within each hour, balance power must be paid for
• As long as no market for intra-day balancing power exists, a modest fixed price may be the route forward
• Careful consideration must be given to implications for wind farm business cases

At system level

• The TSO responsible for security of supply must do his own aggregated wind forecasts updated every 3-5 hours on an on-going basis
• The quality of these forecasts will be better than the individual forecasts because:
  • Continually updated using best available weather forecasts
  • Takes portfolio effects into account (geographic spread, smoothing effects)
Balancing through trading . . .
Balancing through trading...

Namibian grid is very wide, but with strong connectors.

Wind turbines will not be connected on the main grid, but at a lower voltage.

Balancing of production will take place far away from turbines.

Wind farms as active grid supporters is an important feature.
A very big part of consumption is imported. If possible, the connectors should be activated for balancing.
Imports becoming more uncertain due to reduced reserve margins in SA

A plan to gradually transition away from bulk imports but rather use interconnectors for balancing should be considered
How can the Namibian grid be protected against failures?

- **Grid codes for wind power plants**
  - To be based on international best practice and standards (Some TSOs having worked with high penetrations for some years offer assistance as consultant (e.g. the Danish TSO Energinet.dk, whose grid codes are available on their website)
  - LVRT should be required from the start to avoid situations as seen recently in China
  - Require centralized monitoring from TSO control room including emergency shutdown (for wind farms over a certain size, e.g. 30-40MW)

- **Grid codes for all other generators**
  - Gradual move towards more flexible generation and lower minimum loads etc.
Assumed (theoretical) merit order in Namibia (marginal costs)

1. Hydro

Wind Power Plants will be ranked according to a very low marginal cost corresponding to O&M costs

2. Import

3. Coal firing

4. Diesel plants

5. Distributed Peak Power

6. Demand response options

However, it is imperative for the business case certainty, that a wind power plant is guaranteed offtake. If curtailed, the owner must be compensated proportionally. In the EU such priority access is required by the EU Commission.
Assumed merit order model Namibia Right or wrong?

- Peak Power
- Diesel Paratus
- Import from north
- Coal Van Eck
- Import from SA
- Hydro Ruacana

- Price
- Relative price
- MWh
- Wind biomass
- Dry year - Wet year
- Consumption

TWh/year
Major power system challenges in Namibia calling for action

- High imports from neighbouring countries at increasing prices
- Reserve margin in SA reducing. Ageing generation mix in SA and high growth in their own demand
- Security of supply
- Reducing fuel price volatility
- Growth of energy demand - need for new capacity
- Grid stability
- Cost efficient system operation. Stable electricity prices facilitates growth in economy
Planning tools capable of simulating the least cost route for development of the Namibian power system

It is possible to simulate the operation of the total grid in Namibia with various combinations of Wind power and eventually other new plants to find the best way of operating the system securing supply at lowest cost.

Examples of use of the open source Balmoral model
- South Africa
- Denmark
Conclusion/recommendation

- Namibian system able to balance around 100MW of wind power short-term
- In the mid-term, more flexibility can be added via hydro storage and activation of interconnectors for balancing (SAPP). This will enable capacity to balance more wind
- Strict grid-friendly grid codes for wind should be enforced early on
- Forecasting requirement on owners of wind farms should be considered.
- NamPower should consider building in-house wind forecasting capability
- Wind and solar PV complements each other and fits well with Namibian load curve
Thank you
Discussion – Grid integration next steps

Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia
Coffee Break

We will resume in 15 minutes
Session 3: Finding a feasible financial model

14:30
Project economics in Namibia
Mr. Phylip Leferink, Vice President of Sales, Vestas

15:00
Overview of financing instruments to improve bankability
Mr. Stuart Smith, Director of Vestas Structured Finance

15:30
Practical challenges in securing financing for a wind project
Mr. Carlo van Wageningen, Chairman of Lake Turkana Wind Power

16:00
Discussion – Financing next steps
Mr. Kudakwashe Ndhlukula, Polytechnic of Namibia

16:15 Coffee break
Project Economics in Namibia

Mr. Phylip Leferink
VP Sales, Benelux and Southern Africa
Vestas Central Europe
1. Cost of Energy (CoE)

2. Cost and Pricing Structure of a Wind project

3. Unique challenges and opportunities in Southern Africa
CoE in Namibia is expected to increase further

Global fuel prices and local economic growth drive electricity prices

Average price per kWh sold

Wholesale electricity price is expected to increase to 1 n$ per kWh by 2016

Externalities not considered in Cost of Energy

Increasing global demand for oil drives prices

International Monetary Fund, World Economic Outlook (WEO), 2011 Edition:
“The persistent increase in oil prices over the past decade suggests that global oil markets have entered a period of increased scarcity. Given the expected rapid growth in oil demand in emerging market economies and a downshift in the trend growth of oil supply, a return to abundance is unlikely in the near term”

Annual Energy Production and Cost of Energy

**Annual Energy Production**
*(in MWh)*

- 300,000
- 250,000
- 200,000
- 150,000
- 100,000
- 50,000
- 0

**Cost of Energy**
*(in cN$ per kWh)*

- 140
- 120
- 100
- 80
- 60
- 40
- 20
- 0

---

**Namibia has excellent wind conditions which can maximize wind power plant output and return of investment.**

**Cost of energy decreases with project size (economies of scale) and increasing wind speed.**

---

*AEP numbers based on 66 a V112 MW wind park, assuming standard air density 1.225 kg/m$^3$, 95% availability, 3% transmission losses, 93% park efficiency.*
1. Cost of Energy (CoE)

2. Cost and Pricing Structure of a Wind project

3. Unique challenges and opportunities in Southern Africa
Cost of Energy embraces all aspects in wind power performance

\[ \text{CoE} = \frac{\text{Annualized CAPEX} + \text{Annualized OPEX}}{\text{Annual Energy Production}} \]

**CoE [EUR/MWh]**

- **CAPEX [EUR/year]**
  - Turbine supply agreement
  - Foundations
  - Electrical infrastructure
  - Installation, construction and other items (BOP)
  - Operation, Maintenance and administration cost

- **OPEX [EUR/year]**
  - Power curve and average wind speed
  - Availability, Wake, Electrical losses

- **AEP [MWh]**

**View/Header and Footer**

To add pre-formatted bullets please use the increase/decrease indent buttons found in the PowerPoint menu.
Estimated Project Costs of a typical wind park in Southern Africa
Cost levels vary on location, project size, turbine type and grid connectivity

Besides wind turbine costs, a project faces many costs that are not directly linked to park/project size:
• pre-development
• legal fees
• project/construction management
• grid connection
## Wind Project Pricing: Foreign Currency vs. Namibian Dollars

<table>
<thead>
<tr>
<th>WTG</th>
<th>Foreign Currency</th>
<th>Namibian Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WTG components: (Nacelles, Blades, Towers, Control Systems)</td>
<td></td>
</tr>
<tr>
<td>TCI</td>
<td>Ocean Freight (shipping) - V90 2MW, V112, V100: mainly from Europe</td>
<td>Local transportation, cranage,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installation</td>
</tr>
<tr>
<td>BOP</td>
<td>Balance of plant, foreign labour</td>
<td>Balance of Plant, local labour</td>
</tr>
<tr>
<td></td>
<td>Remaining BOP components not available locally</td>
<td>All BOP components if available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>locally</td>
</tr>
<tr>
<td>Service</td>
<td>Spare Parts for Service (65%)</td>
<td>Local labour costs for maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(35%)</td>
</tr>
</tbody>
</table>

At time of financial close, clients normally hedge currency risk with positions that are aligned to payment milestones to the project.

**Cost of hedging can be compared to South African costs**
Project Economics – Typical Cash Flow Calculation

Cash Flow

- tEUR

Years

- Operating Expenses
- Net Income Taxes
- Net Interest Inc./Exp.
- Principal Repayments
- Free Cash

WindTalks NAMIBIA
How to secure Business Case and improve CoE?

Value of certainty

The wind turbine represents 60-70% of the initial project costs.

100% of a project’s revenue requires that the wind turbine performs to specifications.

**Cost Certainty**
- Experience in project development
- Long term service agreement covering main components (Active Output Management)

**Revenue Certainty**
- Qualified wind measurement checks
- Selecting the right turbine for the site
- Optimal site design (CFD modeling, site check, jetstream, etc)
- Guaranteed turbine availability
1. Cost of Energy (CoE)

2. Cost and Pricing Structure of a Wind project

3. Unique challenges and opportunities in Southern Africa
Challenges & Opportunities

Challenges:
- Limited (if any) TCI resources
- Sites may be remote; (high logistical and power transmission/distribution costs)
- Grid integration of WF’s may prove to be challenging at times
- Providing a stable and predictable regulatory environment

Opportunities:
- New markets with rapidly growing energy demand
- Rapid growth requires swift generation capacity increases.
- Renewables in general, but wind energy in particular, can be realized on short timelines.
- Projects are generally of substantial size
- Perceived risk higher than the reality; potential for safe and higher returns
Thank you
Session 3: Finding a feasible financial model

Overview of financing instruments to improve bankability

Mr. Stuart Smith,
Director, Vestas Structured Finance
Agenda

1. Global Financing Environment
2. Potential Financing Solutions - Namibia
3. Vestas’ relationship with ECA’s, DFI’s and Multilaterals
4. EKF & its involvement in Vestas contracts
5. Structured Finance at Vestas
**Financing Environment**

**Deleveraging continues**

- Difficulty funding dollars (again)
- Recent project finance portfolio sale occurred at an 8% discount to par
- Multiple European project finance asset sales now occurring – pricing precedent
- Asset sales below par may be expected to reduce market capacity

---

**Rebalancing**

- Additional pressure on capital

---

**Basel III**

- ECAs active in supporting OECD deals
- ECA-insurance cover is very attractive for lenders
- Development banks raised their financing of clean energy projects in 2010 by over 4 bn USD to 13 bn USD
- Similar performance expected for 2011
- Regional development banks also more active

---

**Support**

- Markets will remain dynamic
- Vacuums get filled – the ECAs and multilaterals have stepped up
- New players will get drawn in
Financing Environment

Behavioural changes

- Infrastructure projects, executed in stable legal/regulatory framework, generating predictable cash flows are still attractive to lenders – but availability of long term funding is a growing challenge
  - Credit committees are cautious and unpredictable

- Banks are relationship rather than deal driven
- Fewer banks active in each region, with less competition
- Basel III forces a focus on core relationships

- Smaller positions per project, more banks around the table

- Volatility may continue, players may shift or drop over night
- Pursue multiple paths
- Keep your eye on the market sweet spot for fund availability

- Minimize execution risk first
Financing Environment

The policy players step up

- More “public” participation available and under utilization

Project limits

- Multilateral s can max. fund 50% of project costs
- ECAs are restricted by OECD rules on export

Credit limits

- Multilateral s and ECAs have portfolio management in place and have “one obligor” exposures. This is also the case for strong investment grade utilities
- Both parties can syndicate/re-insure with relevant parties

Political mandate

- ECAs, DFI’s (global and regional) and Multilateral s have different focus from banks
- Political mandates have been expanded throughout crisis – “counter cyclical” action

- Multilateral s, Development Banks and ECAs have expanded their mandates but are not a 100% substitute to banks
- Combining 2 or more IFI’s can often bridge funding gap where banks are not present/active
Financing Environment

Regional

Demand
• Potentially significant activity in South Africa may stretch regional players

International participation
• Choppiness likely to continue (but will pass)
• Support from policy lenders highly desirable, at minimum

Basics
• Regulatory structure, mandate, policy mechanism, cost recovery and funding
• Solid PPA that’s good for both counterparts
• P50 1.5x, P90 1.2x, P99 1.0x

Scarcity value
• A well structured Namibian power deal will draw attention
• More so for a renewables opportunity

• Thoughtful market approach required
• Get the basics right
• Opportunity to create competitive tension
Potential Options
Potential Options

- **EKF (Danish ECA)**
  - Provides guarantee so funding banks face AAA-credit
  - Can provide long-term loans (15-18 yrs)
  - Subject to country limits

- **IFC, MIGA (World Bank Group)**
  - Multilaterals
  - Special relationships with developing world governments can mitigate political risk

- **US Exim/OPIC**
  - Can fund turbines produced in USA

- **Export Credit Agencies**
  - Asia (Kexim, JBIC, Cexim, etc.)
  - Europe (CESCE, SACE)

- **Development Banks**
  - IFU (Denmark)
  - African Development Bank
  - Development Bank of South Africa
  - DEG (Germany)

- **Commercial Banks**
  - Standard Bank, Nedbank, Standard Chartered, and others.
Potential Options

A Closer Look at IFC and MIGA

IFC (International Finance Corporation)
- Can provide up to 50% funding
- Commercial banks more willing to participate with “B” loans due to the political mitigation of IFC and de facto preferred creditor status
- IFC are w/ tax exempt and this extends to the commercial banks in B-loans, which broadens participant bank group

MIGA (Multilateral Investment Guarantee Agency)
- Provide political risk insurance to investors and lenders
- MIGA Guarantees may be backed by Government indemnity or may be given independent of a government counter-indemnity

Future EU Guarantee Facility?
- Bilateral initiative by Vestas/EU under discussion
- Proposal for EU to create a guarantee facility for investments in sub-saharan Africa
Potential Options

Vestas’ Global Sourcing Opens up Financing Opportunities

- **Asian ECAs**
  - Can provide up to 80% funding
  - Tenors generally longer than Commercial banks
  - ECA’s have different mandates than banks and more aggressive in support of national exports
  - Could be relevant for Vestas Production and also if part of construction done by Asian firms

- **US Exim**
  - Direct Funding opened up by Vestas production in USA
  - US Exim have declared Sub-saharan Africa a focus area
  - Longer tenors than commercial banks

- **Spanish/Italian ECAs**
  - CESCE (Spain) and SACE (Italy)
  - Funding/guarantees driven by Vestas production in Spain/Italy
Case Study: Vestas Turbines in Cape Verde

- Project Cape Verde: 30 x V52-850 kW
- First large-scale wind power plant in Cape Verde and one of the first in Africa
- 30 mn € direct loan by EIB
- 15 mn € direct loan by African Development Bank (AfDB)
- Owner: local utility Electra
Case Study Namibia: Ohorongo Cement Factory EIB Financing

- Ohorongo Cement Plant: EUR 250 mill. Project
- 82 mn € direct loan from EIB
- Additional loan amounts from DEG (Part of KfW Banking Group) and Development Bank of South Africa (DBSA)
Potential Options with Vestas
Vestas Relationships Help Build the Credit Story

Strong global and regional contacts

Vestas has strong co-operation with ECA's, DFI's and Multilateral.

- Vestas production base opens up co-operation with multiple ECA’s (EKF Denmark, SACE Italy, CESCE Spain, US Exim, OPIC US and China Exim/CDB/Sinosure - China) and sub-supplier base widens this further
- Deal expertise with DFI’s (IFU, DEG and FMO)
- Deal expertise with Multilateral (IFC, EIB)
- Deal expertise with Regional development banks (AfDB)
Vestas and Eksport Kredit Fonden (EKF) have been partners for many years. This has resulted in landmark deals to the benefit of Vestas’ customers in OECD markets as well as emerging markets.

- Vestas is EKF’s largest customer (size and number)
- USD 365 mill. Project Finance + first use of export lending scheme in Australia
- First Offshore Project Finance deal in Europe (Q7) + multiple offshore transactions thereafter
- Numerous transactions in developing economies
EKF & its Involvement in Vestas Contracts
What does EKF do?

- The Danish Export Credit Agency
- Guaranteed by the Danish Government
- AAA-rated sovereign risk cover
- Supports and supplements private sector lending
- Insures against risks in the financing of export- and investment projects
- Cover pre- and post construction
- Operates on commercial terms and conditions
- Temporary EKF funding scheme introduced in 2009 – extended until 2015
- The ECA with largest renewable energy (wind) portfolio
- Sourcing flexibility – Vestas production in Denmark and elsewhere
General Issues

Danish Interest
- Involvement due to Vestas contracts
- Made by Vestas vs. made in Denmark
- EKF reinsurance with other ECA’s

Terms & conditions
- Tenor up to 18 y tenor post completion (AWL 11y)
- On project finance typically 80% risk cover
- EKF risk premium reflects bank’s risk pricing

Project due diligence
- EKF project due diligence similar to commercial banks
- EKF risk sharing with banks
- EKF assumes documentation risk (part of negotiation)

Environmental due diligence
- EKF due diligence on environmental issues. In Project finance deal, the Equator Principles will apply, i.e. EIA and monitoring

Confidentiality
- EKF will sign NDA if so requested
- EKF operates with Chinese walls as banks do
- EKF requires openness “post closing”

EKF declaration
- Vestas, Financier(s) and Customer must sign “EKF declaration” on “non bribery and openness”
Structured Finance at Vestas
Structured Finance in Vestas
Newly established with global responsibility

Structured Finance

- Part of Vestas Group Treasury, based in Zurich, Switzerland
- Former energy investment bankers (e.g. ABN Amro, Credit Suisse, Morgan Stanley) and ECA project finance specialists (EKF, Maersk)
- Strong relationships with financiers active in renewable energy - banks, infrastructure funds, pension funds, export credit agencies, multilaterals, development finance institutions, and institutional investors
- Capabilities in debt and equity advisory services, deal structuring and deal execution
- Currently a team of five, plus a legal and risk team
Thank you
Mr. Stuart Smith,
Director, Vestas Structured Finance

Thank you
Practical challenges in securing financing for a wind project: The Lake Turkana Wind Power experience

Mr. Carlo van Wageningen
Chairman of Lake Turkana Wind Power
First, the good news

1) **Money is out there**: More than USD 7 Billion are available for bankable infrastructure projects in Africa. Mainly with Development Financial Institutions (DFI)

2) **Strong Interest**: Appetite by Equity funds to invest is high. Returns on investment in Africa are high, and in Developed economies they are getting lower by the day.

3) **Governments are on-side**: Most African Governments have come to the realization that economic growth can only be achieved with through improving infrastructure to meet the demands of a growing economy. Large investments in the Energy, Transport and Communication sectors are needed.

4) **Public to Private**: African Governments have turned to the Private sector to achieve this growth. Traditionally these were state monopoly sectors.

5) **Partnerships**: In order to attract Foreign Direct Investment and local private sector participation, many African Countries have put in place attractive tax incentives. Public-Private Partnerships are now possible, and in many cases they are governed by sound guidelines and policies.
Now, the bad news

1. **Static Financing Models**: There are few players and little competition in the DFI community, therefore no innovation in financing models which are often punitive to the project developers and investors.

2. **Africa Risk Premium**: Perceptions of “Africa Risk” are costly; State Corporations in Sub-Saharan Africa have no international credit ratings, so risk perception on them is therefore high. The mitigating factors are consequently very time-consuming and very expensive to investors and State Corporations – increasing project costs by approximately 30% compared to the same project in Developed economies.

3. **Debt/Equity challenges**: In Europe you can achieve a 97% to 3% Debt/Equity ratio on a Wind Power project. In Sub-Saharan Africa, the range is 70% to 30%, which is expensive to the developer.

4. **Large Infrastructure Costs**: Often, limited infrastructure network (roads, electrical grid...etc) require direct capital interventions, further increasing project costs and above all generates interface risks which lenders want mitigated through “Wrap” solutions. Again more cost!

5. **Penalty on Success**: If you are a local successful Project Developer in Africa then you are also suspicious, which triggers all kinds of Governance issues which are again punitive on the Developer.
The weakest link!

1. **Cost**: Developing a Wind Power project is expensive – generally between 3% and 5% of total project cost

2. **Development Costs**: There are only a few financial institutions who provide limited contribution towards Project Development Costs. Capital Market Authorities in Sub-Saharan Africa (where they exist) do not allow Start-up IPO’s and Private placements are illegal.

   Project Developers are expected to meet these costs from their own resources or they need to be inventive and innovative in raising needed seed capital to develop the project. This is not easy and not in everyone’s reach.

3. **High-risk capital**: Unless the Developer has deep pockets, appetite for high risk and thorough knowledge of Project Finance and the financing requirements, then think twice before you venture into it.
So how did LTWP manage the process?

The 6 founders of LTWP bring thorough and proven experience in:

• Project development in Africa.
• Development of wind farms in Europe
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They quickly proved to be a formidable and dedicated team:

• Everyone’s input was valued by the rest
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They knew they had identified a potentially excellent wind site, but they also realized that the challenges to erect 365 wind turbines on this site and connect them to the national grid was going to be a mammoth task
What were the specific challenges?

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**First-of-its-kind project:** There was very limited prior local experience or knowledge on wind energy or wind energy Power Purchase Agreements. Obtaining the required government, electricity off-taker and regulator support was going to be a challenge
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Mr. Carlo van Wageningen,  
Chairman of Lake Turkana Wind Power

Thank you

*We take this opportunity to extend our gratitude to the Government of Kenya, KPLC, ERC. and KETRACO for the unwavering support and faith they have extended to this challenging project*

*It is our sincere hope that other African Governments will want to follow in Kenya’s footsteps as this is a perfect example of a successful Public-Private-Partnership that can pave the way for further large foreign direct investment opportunities in the region*
Discussion – Financing next steps

Mr. Kudakwashe Ndhlukula,
Coordinator at REEEEI, Polytechnic of Namibia
Coffee Break

We will resume in 15 minutes
Wrap-up Session: Connecting the dots

16:30
Summary: Steps towards the first wind farm project
Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia

16:45
Way forward: next steps and future cooperation
Mr. Hans Vestergaard,
Senior Vice President of Vestas Sales

17:00
End of official program & Cocktail

18:00 Dinner
Summary: Steps towards the first wind farm project

Mr. Kudakwashe Ndhlukula,
Coordinator at REEEI, Polytechnic of Namibia
The way forward: next steps and future cooperation

Mr. Hans Vestergaard,
Senior Vice President of Sales for Vestas Central Europe

Vestas®
End of official program & Cocktail

Thank you

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