Wind Generation in Walvis Bay
Erongo Regional Electricity Distribution Company, NAMIBIA

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Summary
A utility-scale wind energy converter was connected to the electricity distribution grid of the ErongoRED to exploit the wind resources at the coastal town of Walvis Bay, Namibia. This DANIDA funded project constituted the first renewable energy initiative based on wind generation by a Local Authority in Namibia and southern Africa.

Apart from supplementing the power supply to Walvis Bay and, in particular, consumers at Mile 7, the project provided a learning environment to develop local expertise in the assessment, design, implementation and operation of grid-connected wind energy converters. In addition, this pilot project will provide a basis for assessing the feasibility of a large-scale (10 MW) wind farm.

The project is replicable in other countries but should take guidance from the lessons learnt. These include prior in-depth assessment of refurbished wind turbines (if applicable), capacity to operate pilot plants which have no economies of scale, risk mitigation for the local contracting parties, obligatory information sharing between international and local partner companies and allowing for as realistic implementation time frame.

End-user area

[ ]	New buildings
[ ]	Refurbishment of buildings
[ ]	Transport and mobility
[ ]	Financial instruments
[ ]	Industry
[ ]	Legal initiatives (municipal regulations, directives, etc)
[X]	Planning issues
[ ]	Sustainable communities
[ ]	User behaviour
[ ]	Education
[ ]	Other

Target Audience

[ ]	Citizens
[ ]	Households
[ ]	Property owners
[ ]	Schools and universities
[X]	Decision makers
[X]	Local and regional authorities
[ ]	Transport companies
[X]	Utilities
[ ]	ESCOs
[ ]	Architects and engineers
[ ]	Financial institutions
[ ]	Other

Technical

[ ]	Energy efficiency
[ ]	Heating
[ ]	Cooling
[ ]	Appliances
[ ]	Lighting
[ ]	CHP
[ ]	District Heating
[ ]	Solar energy
[ ]	Biomass
[X]	Wind
[ ]	Geothermal
[ ]	Hydro power
[ ]	Other

Introduction
Namibia's energy policy framework supports the active utilisation of the country's renewable energy resources. A Local Agenda 21 project carried out in Walvis Bay, NAMIBIA through the Municipality of Walvis Bay (later the ErongoRED) and supported by the Danish Government paved the way for the official and popular adoption of wind generation as a possible alternative to conventional energy supply.

The project set out to install a 220kW wind turbine as a pilot and in this process build capacity and provide a demonstration project. The programme constitutes the first renewable energy generation initiative by a Local Authority in Namibia and southern Africa that is based on embedded wind generation.

Objectives

The objectives of the project were three-fold:

- Implementation of a pilot, grid connected, wind generator at Mile 7 substation near Walvis Bay
- Building of local capacity:
    - in management and planning of wind turbine implementation (resource assessment, EIA, business plan, technical specifications, contract supervision).
    - in the implementation of wind turbines (construction, erection, electrical connection, operation, professional maintenance).
    - in the operation, basic maintenance, data collection and administration of embedded wind generation by the utility.
- Demonstration of utility scale wind energy in Namibia.

Deliverables

The project consisted of two distinct phases: The preparatory phase and the implementation phase. The preparatory phase included the following activities:

1. Environmental Impact Assessment: The assessment considered the overall acceptability of potential environmental and social impacts likely to arise as a result of the construction and operation of the wind turbine. The assessment concluded that there would be no adverse long term or cumulative effects/impacts. As part of the assessment two public meetings were facilitated in Walvis Bay.
2. Quality of Supply monitoring: A QoS meter was installed at the Mile 7 substation to monitor and learn about the impact of wind generation on the electricity grid. To date neither positive nor negative impacts could be observed from the connection of the wind energy converter, keeping in mind that this is a small installation.
3. Wind resource assessment: Due to the short implementation time of this project and the limited budget, no wind data monitoring was performed at the identified installation site. Instead wind data records captured in the vicinity were transposed through the use of the WindPro software.
4. Wind energy generation assessment: Through the use of the modelling software WAsP it was established that a capacity factor of about 18% and 14% could be expected at a hub heights of 40m and 30m.
5. Business plan for the single wind turbine: The business plan took into account the income from generation and the costs of maintenance, replacement and administration.

Implementation phase: A refurbished 220kW, three-blade, stall-controlled Wind World W-2500 turbine (1989 manufacture), with a rotor diameter of 25m and a hub height of 31m was installed in November 2005. This involved the bid preparations, a tendering phase, bid evaluation, contract appointment, implementation, supervision, commissioning, operation and maintenance of the wind generator.

Financial resources and partners

The project was funded by Danida to a value of € 250,000 with in kind contributions by the Municipality of Walvis Bay/ErongoRED. The project was managed by EMCON Consulting Group (Namibia) in collaboration with AGAMA Energy (South Africa), PA Energy (Denmark), the PolyTechnic of Namibia, Geo cc (South Africa), Joubert Steyn (South Africa) and Seal Consulting (Namibia). Project components were implemented by Engineering Centre (Namibia) in conjunction with Storstrom Vindkraft (Danish) and Walcon Construction (Namibia) in terms of the wind turbine implementation and EnviroSolutions (Namibia) in terms of the Environmental Impact Assessment.

Outcomes

The key outcomes of this project are a wide range of capacity building achievements, an operational wind turbine on the Namibian electricity grid, a clear business directive for future wind parks and valuable lessons learnt. The outcomes are summarised as follows:

- Capacity building: The project was multi-faceted and different sectors gained from the project. The capacity building included:
    - Wind turbine implementation planning and coordination
    - Environmental Impact Assessment with respect to wind turbines
    - Awareness building through public participation process
    - Wind resource assessment
    - Site suitability assessments (Soil conditions, foundation design)
    - Wind turbine installation involved a number of local contractors
    - Commissioning of a wind turbine
    - Operation and maintenance of the Wind World wind turbine at utility and private sector level
    - Monitoring of the wind energy generation performance by the utility and local research institutions
- The wind turbine is estimated to produce about 260MWh per annum. The project generates a small profit over ten years (Euro 10,000) at an initial generation tariff of 1.8c/kWh coupled to a green premium tariff of 0.55c/kWh through the sale of green electricity based on the project being grant funded.
- A future 10MW wind park would require a 4.7c/kWh breakeven tariff (at 11% commercial lending rate) assuming a 22% capacity factor (closer to the coast) with no grant funding.

The objectives of this project were firmly met through thorough capacity building, local ownership and a high quality wind turbine implementation. In addition, the wind turbine attracts substantial interest from Namibians visiting the coast – more than had previously been anticipated, therefore enhancing the demonstration and awareness creation value of this project.

Lessons learned and repeatability

This was the first wind turbine implementation in Namibia and therefore all parties stood to learn something. In that regard the project added immense value to the Namibian energy sector, be it the client, the operator, the consultants or the contracting parties.

The lessons learnt have been summarised below with mitigating measures where appropriate:

- The purchase of used or refurbished wind turbines is risky in terms of the state of the hardware.
    - In order to reduce that risk it is recommended that in future a budget is allocated for physical inspection of WEC by consultant/contractor (with specialist help) of the receiving country prior to shipping. During that inspection the record of the wind turbine operation and the refurbishment reports have to be provided.
- Single pilot wind turbine implementations are expensive (no economies of scale) and difficult to sustain in terms of operation and maintenance.
    - Ensure that the capacity building warrants the cost.
    - Ensure that the continuity for long-term operation through the owner/operator is given.
    - Ensure that there is support for the technology for the expected lifetime of the wind turbine – a non-functional wind turbine is a major barrier to further wind park implementation plans. Therefore, ensure that in the case of a refurbished unit the model is not older than ten years.
    - Ensure that the basic and most critical spare parts are available.
- The implementation of such a project requires strong local contracting capacity.
    - Ensure that contractors have implemented projects of similar size and complexity.
    - Ensure financial strength of the main contracting party.
- A strong focus was put on the local content in the implementation contract. The TORs for the implementation contract specified that a local contractor was to be the main bidder, in

partnership with an international wind turbine supplier and specialist as well as a local civil contractor for the foundation work. Although this is an ideal constellation as one ensures much more local ownership, responsibility and capacity building in this way, it is also a very risky project for the local main contracting party, due to this being an unknown area for the contractor. In addition it can be assumed that the local main bidder and the international supplier do not have a prior business relationship which adds to the risk.
    - The local ownership at consulting and contracting level has lead to immense capacity building in the field of wind energy implementation.
    - Consider measures to mitigate some of the risks.
- It is important that real information sharing takes place at an early stage in the project. This point refers in particular to the relationship between the main bidder and the international supplier, where the detailed implementation plans and technical documentation were not forthcoming. Although a wind turbine has now been installed, the key documentation is still lacking.
    - The overall project implementation plan needs to request technical documentation of the WEC and hardware implementation plans as a deliverable and a project milestone.
- The risk in hardware implementation programmes is often that the hardware component dominates and the capacity building aspects come in at lower priority.
    - It is recommended that the TORs of contracts specify the time to be spent on capacity building activities and ensure that payment occurs against these deliverables.
- The time required for the physical contracting/implementation work of the wind turbine requires sufficient time, especially if this is the first unit that is being installed and capacity building is part of the scope.
    - The consultant needs to specify the time for the installation in the bid, as otherwise this is usually reduced to a minimum for the bidders to be competitive. The installation process and the operationalisation of the wind turbine are key events that need to be taken more slowly in order to broaden the impact.
- The project demonstrated that it is possible to implement a pilot wind project within a year's time.

The Walvis Bay wind project is replicable in other countries. However it is recommended that future projects learn from the lessons learnt in the Walvis Bay project and give careful consideration to the implications of pilot projects in terms of sustainability with regards to human resources, replacement parts and technical support.

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Reports and bid documents available:
Wind Generation in Walvis Bay - Project completion report – May 2006
Wind Energy Resource and Generation report – April 2005
TOR for Environmental Impact Assessment – March 2005
Business plan for Walvis Bay Wind Energy Generation – March 2006
TOR for Wind Energy Converter implementation – April 2005

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