our future through science

South Africa – a new innovator and manufacturer of wind turbines?

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INTRODUCTION

The GEF-funded South Africa Wind Energy Programme (SAWEP) was designed to reduce greenhouse gas emissions generated from thermal power in the national inter-connected system. The objective of SAWEP is the removal of barriers towards wind energy development in South Africa. These barriers include regulatory, institutional, financial and information, knowledge and capacity barriers.

SAWEP also aims to achieve key strategic outputs that will guide South Africa on wind energy development. One of these outputs is the Wind Atlas for South Africa (WASA), which will play a significant role in providing information for potential investors for wind farms on areas that have opportunities. Another output is the development of a Wind Energy Industrial Strategy for South Africa. The Wind Energy Industrial Strategy project aims to play a strategic role in paving the way for the gradual phasing in of wind energy in South Africa.

This poster presents an overview of the Wind Energy Industrial Strategy that was developed by the CSIR and DTU Wind Energy of Denmark (formerly Risø-DTU).

OBJECTIVES

The South African Department of Trade and Industry (**the dti**) has a methodology for developing Customised Sector Programmes (CSP's) to generate well-formulated strategies, which are developed to support the Industrial Policy and Action Plan (IPAP) of **the dti**.

IPAP is a formal policy in support of the up-scaling of efforts to promote long-term industrialisation and industrial diversification beyond South Africa's current reliance on traditional commodities and non-tradable services.

The objective of the Wind Energy Industrial Strategy is to research the establishment of a local wind turbine and component manufacturing and services industry in support of IPAP.

This report has been structured to have three parts:
Part 1: Global wind energy market and industry
Part 2: South African wind energy market and industry
Part 3: Strategic analysis (emphasis of this poster).

Scenario	Assumptions	% value	Local spend/ MW	Dates achieved
1. Low-industrial content	Grid connection, civil works, other capital costs, fully imported wind turbines	29	R4.64 million	2015
2. Medium-low industrial content	Grid connection, civil works, other capital costs, tower locally made, rest of turbine imported	47	R7.52 million	2015
3. Medium-high industrial content	Grid connection, civil work, other capital costs, tower, blades, generator and nacelle made locally, rest imported	66	R10.6 million	2020
4. High industrial content	Grid connection, civil works, other capital costs, most of turbine made locally, except for specialised items such as gearbox, rotor bearings	87	R13.9 million	2020

Scenarios for the localisation of wind-energy project spend

A preliminary external macro-environment (big picture) analysis was done of the South African wind energy research, development and demonstration community.

Analysing the data and information gathered, it is recommended that a South African Wind Energy Technology Platform be established in support of a wind energy industrial strategy. The applied technology, or themes, that could form the basis of this platform are:

- Lifecycle evaluation and prediction
- Component design and manufacturing
- Wind farm design optimisation
- Condition monitoring and fault prediction
- Policy development and decision support

South African innovation and ingenuity has resulted in a totally indigenous 300 kW wind turbine that has been designed and manufactured to withstand the rigours of the African continent.

<table>
<tr><th></th><th colspan="5">Preliminary technology tree</th></tr>
<tr><td>Needs</td><td>Innovative wind turbine system designs</td><td>Local manufacture of components</td><td colspan="2">Job creation</td><td>Energy security</td></tr>
<tr><td>Key solutions</td><td colspan="2">• Wind resource assessment and maps
• Advanced designs for next generation wind turbines
• Advanced materials selection and development
• Advanced and cost-effective manufacturing techniques</td><td colspan="3">• High quality manufactured components
• Certification and testing procedures
• Advanced techniques for wind turbine/grid integration
• Human capacity development</td></tr>
<tr><td>Platform</td><td colspan="5">South African Wind Energy Technology Platform</td></tr>
<tr><td>Applied technology</td><td>Lifecycle evaluation and prediction</td><td>Component design and manufacturing</td><td>Wind farm design optimisation</td><td>Condition monitoring and fault prediction</td><td>Policy development and decision support</td></tr>
<tr><td>Base technology</td><td>• Constitutive equations
• Materials characterisation
• Aero-elasticity methodologies
• Numerical failure identification methods
• Non-destructive evaluation</td><td>• Database of new materials
• New design standards
• Power electronics
• Manufacturing processes
• Quality assurance</td><td>• Increased accuracy of wind resource database
• Wind turbine emulation system
• Extreme wind condition evaluation techniques
• Complex terrain and offshore evaluation techniques</td><td>• Monitoring and evaluation
• Supervisory Control and Data Acquisition (SCADA) systems
• Smart grid technologies</td><td>• Data and information evaluation techniques</td></tr>
<tr><td>Infrastructure</td><td colspan="2">• Wind measurement equipment
• Computational fluid dynamics
• Finite element methods
• Dedicated wind tunnels
• Blade test facilities
• Generator test facilities
• Drive train test facilities</td><td colspan="3">• Natural resource databases
• Geographic information systems
• Quantitative methods
• Science and engineering know-how
• Supply chain linkages
• Indigenous knowledge</td></tr>
</table>

Preliminary South African Wind Energy Technology Platform

Picture courtesy of Adventure Power Pty (Ltd)
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STRATEGIC ANALYSIS

South Africa has an active, small turbine industry that not only supplies wind turbines to the local market, but is achieving success through exports.

South Africa also has one wind-turbine company that manufactures a medium-sized wind turbine of 300 kW.

Research and development is undertaken at various institutions and universities in South Africa, with the University of Stellenbosch researching direct-drive permanent-magnet generators. This configuration eliminates the need for gearboxes.

The economics of wind energy projects were investigated, including the costs of the components of a wind turbine as well as the cost breakdown of components per MWp of a wind-energy project. It is estimated that it currently costs ZAR16 million (€2.1 million) per MWp to develop a wind farm. *(**Definition:** MWp is the nameplate or peak generation capacity of a wind turbine. Average megawatt, MWa, is the MWp divided by capacity factor)*

A set of four scenarios were formulated and the localisation value for each scenario was developed. These strategic scenarios were specifically developed to assist the South African government in its formulation of localisation strategies for the wind energy sector.

CONCLUSIONS

The wind energy industrial strategy recommended the following:

- The South African government continue developing and implementing policies that support a sizeable and stable market for wind power, in conjunction with policies that specifically provide support mechanisms for wind turbines and components to be manufactured locally so as to result in a competitive wind industry.
- Current public funding programmes for innovation in South Africa should be intensified and better publicised.
- A dedicated model should be developed so that the potential job opportunities for a South African industry can be more accurately quantified. An expected output of such an analysis would be to establish what the job opportunities are for the range of skills that will be required. Knowing the type of skills required will enable the education and training facilities to develop relevant curricula.
- To develop a globally competitive wind industry, a coherent national certification and testing facility should be investigated.