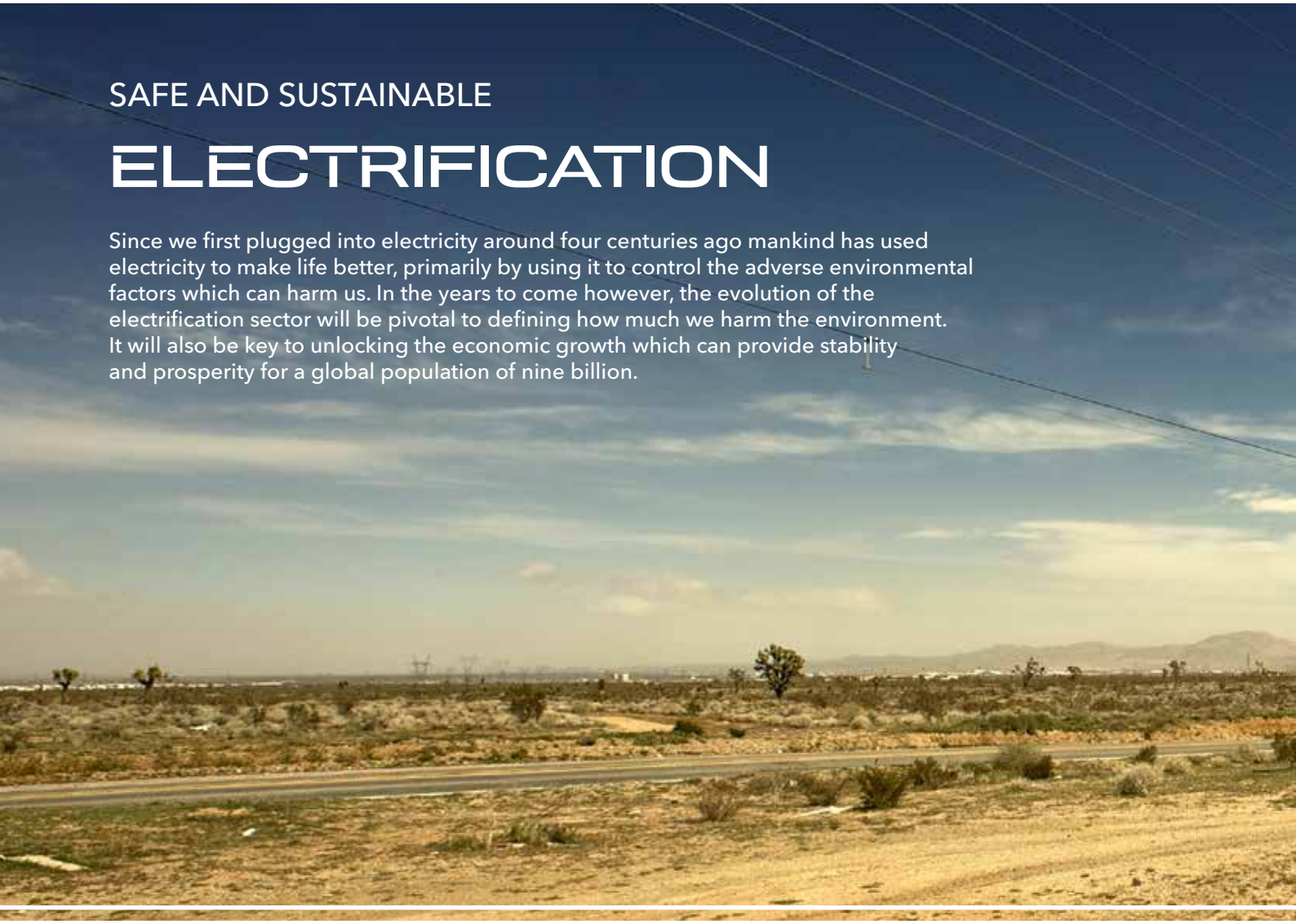
DNV·GL

ENERGY

DNV GL IN SOUTHERN AFRICA

Selected project references

SAFER, SMARTER, GREENER



SAFE AND SUSTAINABLE

ELECTRIFICATION

Since we first plugged into electricity around four centuries ago mankind has used electricity to make life better, primarily by using it to control the adverse environmental factors which can harm us. In the years to come however, the evolution of the electrification sector will be pivotal to defining how much we harm the environment. It will also be key to unlocking the economic growth which can provide stability and prosperity for a global population of nine billion.

INTRODUCTION

Africa is rising and difficulties between balancing economic, societal and environmental needs are growing. Governments and industries are under pressure to utilize safe & sustainable energy solutions to maintain economic growth. We know we can create a future that provides a decent quality of life for growing populations while staying within Africa's environmental boundaries.

Following South Africa's lead of a phenomenally successful REIPPPP, other African nations are starting to unlock their own massive potential of large scale renewable energy with initiatives set to transform the African continent. This is not without considerable technical challenge. For those who act now, there is tremendous opportunity.

With interest in the Africa energy sector increasing so rapidly, **the demand from all stakeholders for high quality, experienced and independent advice has never been greater.** We have carefully focused our global wealth of knowledge and experience in energy to develop a range of services to solve the unique complications and obstacles the industry faces in Africa.

DNV GL is able to combine the benefits of in-country expertise and local offices with its global reach in support of the African market. Large public renewable energy tender rounds are becoming more common around the world; an unmatched pool of talented engineers allows DNV GL to react quickly to the challenges of supporting numerous concurrent projects. Having secured a contract, winning projects can look forward to close support up to financial close, through construction and throughout the operational phase.

Several countries in Africa (such as Ethiopia, Eritrea, Ghana, Kenya, Mozambique, Nigeria, Senegal, South Africa and Tanzania) have stood out with programmes/ projects that support the use of renewable energy. DNV GL has actively participated in (renewable) energy projects in Africa. The project references will be described in the next pages.

DNV GL has offices for the rapidly expanding African region in Algeria, Angola, Egypt, Ghana, Kenya, Morocco, Nigeria and South Africa.
In addition, DNV GL – Energy has local representatives in Kenya and Namibia.

DNV GL'S ELECTRIFICATION VISION 2050

Efficiency
Widespread adoption of modern supply technologies such as smart grids, CHP plants and energy storage solutions have created a much more efficient and effective electricity supply infrastructure, that is capable of dealing flexibly with inputs from variable sources. More energy-efficient appliances and new materials, e.g. for insulation, have reduced the energy needed for specific energy services such cooling or heating.

Clean energy dominance
Emissions in the power sector will be a quarter of today's levels by 2050. The energy mix is characterised by dominating renewable energy sources and a remaining base of low-carbon fossil-fuel technologies. Clean energy use will be backed by tough regulation to penalize carbon emissions; the deployment of hydro, wind or solar power will tend to be determined by geography. i.e. socioeconomic structure, climate and the networks. The shift to new energy sources has also reduced local air pollution, boosting public health.

Decentralisation and democratisation
Electricity has become the essential energy source for transportation and residential energy needs, including heating, and much more of this energy comes from decentralised generation such as micro wind turbines, solar panels on residential roofs or stand-alone combined heat and power stations. These are often owned and operated by local consumers and businesses spurring local and regional development without environmental degradation, whilst ensuring security of supply.

Energy for all
Everybody has access to affordable basic energy services such as heating, lighting and electricity-based household appliances, ending the scourge of fuel poverty. Much of the low-cost energy comes from clean technology sources such as solar.

WHERE WE WANT TO GO: ELECTRIFICATION VISION 2050

Our vision for a safe and sustainable electrification sector is one that is efficient and affordable, and powered by cleaner and more decentralized sources.

25%

Emissions in the power sector will be 1/4 of today's levels by 2050.

100 kWh

per person annually needed to provide basic energy to those who now have none (average US household uses 11,040 kWh per year).

$400 billion

The amount of money the world needs to spend per year to meet the United Nations' goal of bringing clean and modern electricity to all people by 2030.

IN BRIEF

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business.

We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries.
We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.

In the energy industry
DNV GL delivers world-renowned testing and advisory services to the energy value chain including renewables and energy efficiency.
Our expertise spans onshore and offshore wind power, solar, conventional generation, transmission and distribution, smart grids, and sustainable energy use, as well as energy markets and regulations.
Our 3,000 energy experts support clients around the globe in delivering a safe, reliable, efficient, and sustainable energy supply.

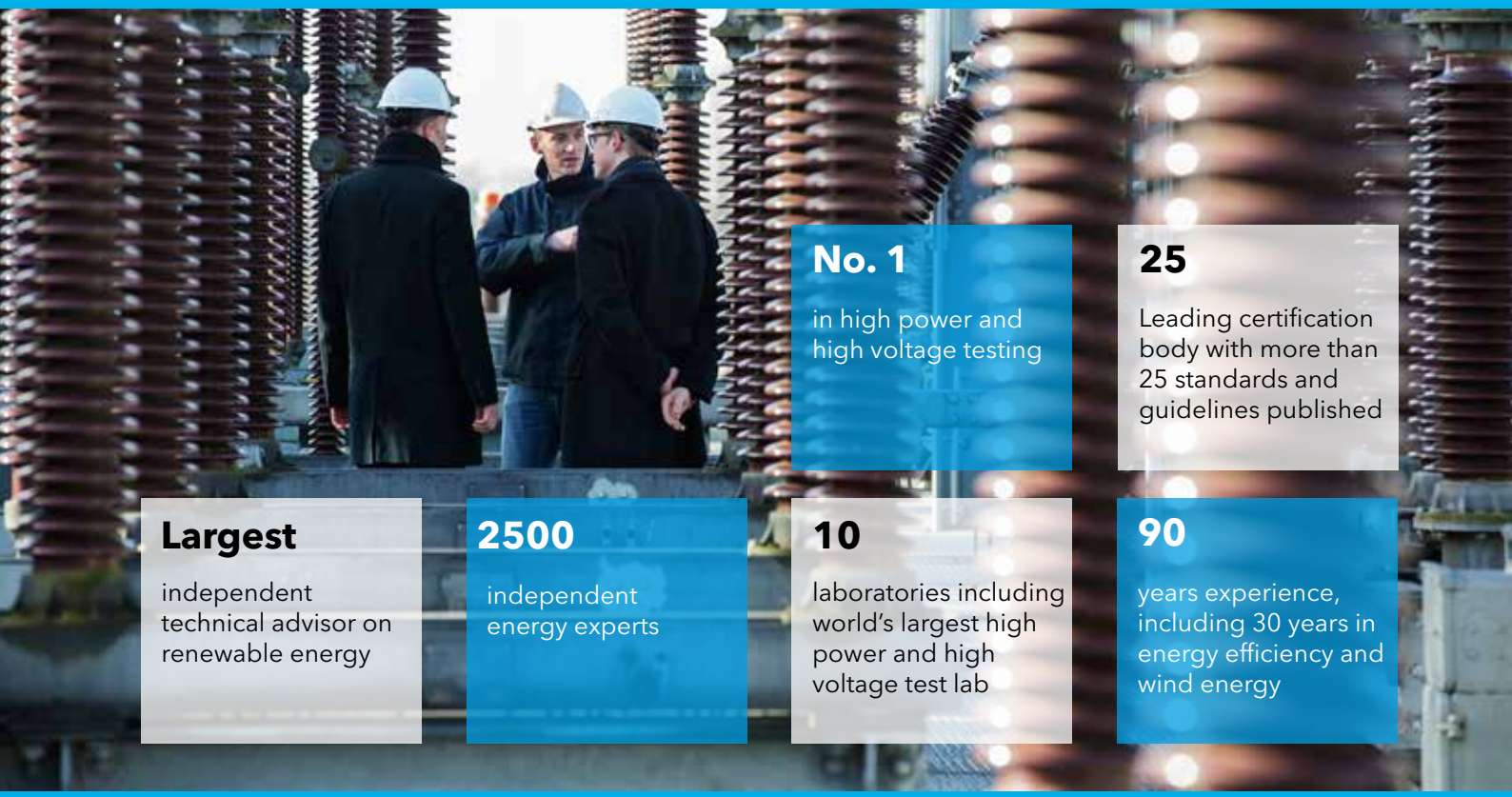
DNV GL - Energy combines the strengths and rich heritage of five well-known brands, DNV, GL, KEMA, Garrad Hassan and GL Renewables Certification.

Besides our advisory and certification services, we also provide trainings ad workshops via teh DNV GL Energy Academy.

DNV GL experts
Our energy professionals combine technical expertise and knowhow of international standards and guidelines, with practical insight in the markets, products and business processes of our customers.

DNV GL customers
DNV GL customers are companies in the energy sector, investors, governments, and major industrial electricity consumers. In addition, our customers also include the energy sector suppliers, manufacturers of electrical components and end products and trading companies such as retailers and wholesalers.

Our vision is for a safe and sustainable energy sector.
We believe key challenges and barriers can be overcome.
The role of DNV GL is enabling the transition.



No. 1

in high power and high voltage testing

25

Leading certification body with more than 25 standards and guidelines published

Largest

independent technical advisor on renewable energy

2500

independent energy experts

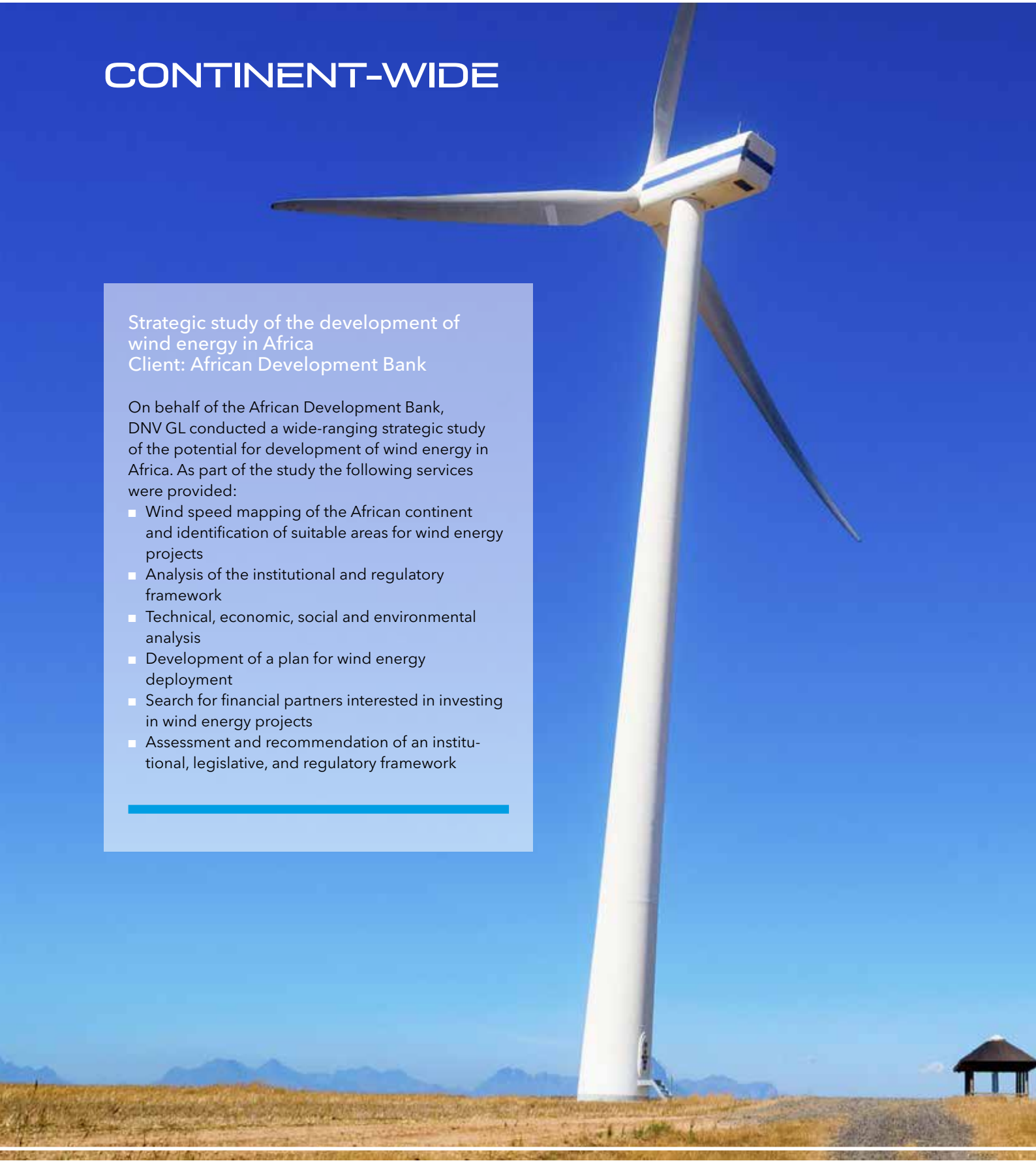
10

laboratories including world's largest high power and high voltage test lab

90

years experience, including 30 years in energy efficiency and wind energy

CONTINENT-WIDE



Strategic study of the development of wind energy in Africa
Client: African Development Bank

On behalf of the African Development Bank, DNV GL conducted a wide-ranging strategic study of the potential for development of wind energy in Africa. As part of the study the following services were provided:

- Wind speed mapping of the African continent and identification of suitable areas for wind energy projects
- Analysis of the institutional and regulatory framework
- Technical, economic, social and environmental analysis
- Development of a plan for wind energy deployment
- Search for financial partners interested in investing in wind energy projects
- Assessment and recommendation of an institutional, legislative, and regulatory framework

Tariff structures for sustainable electrification
Client: European Copper Institute (ECI)

In the context of its initiatives 'Africa' and 'Energy Advocacy' the ECI wanted to develop an understating of electricity tariff structures in sub-Saharan Africa. Through this project, ECI aimed to study the following issues:

- Review of tariff structures in representative countries in Africa
- Assessment of these tariffs, in terms of long-term financial viability for the electricity sector, and to offer a sufficient risk-adjusted return business proposition to attract sufficient private capital
- Suggestions how to evolve to a more healthy tariff structure, where needed

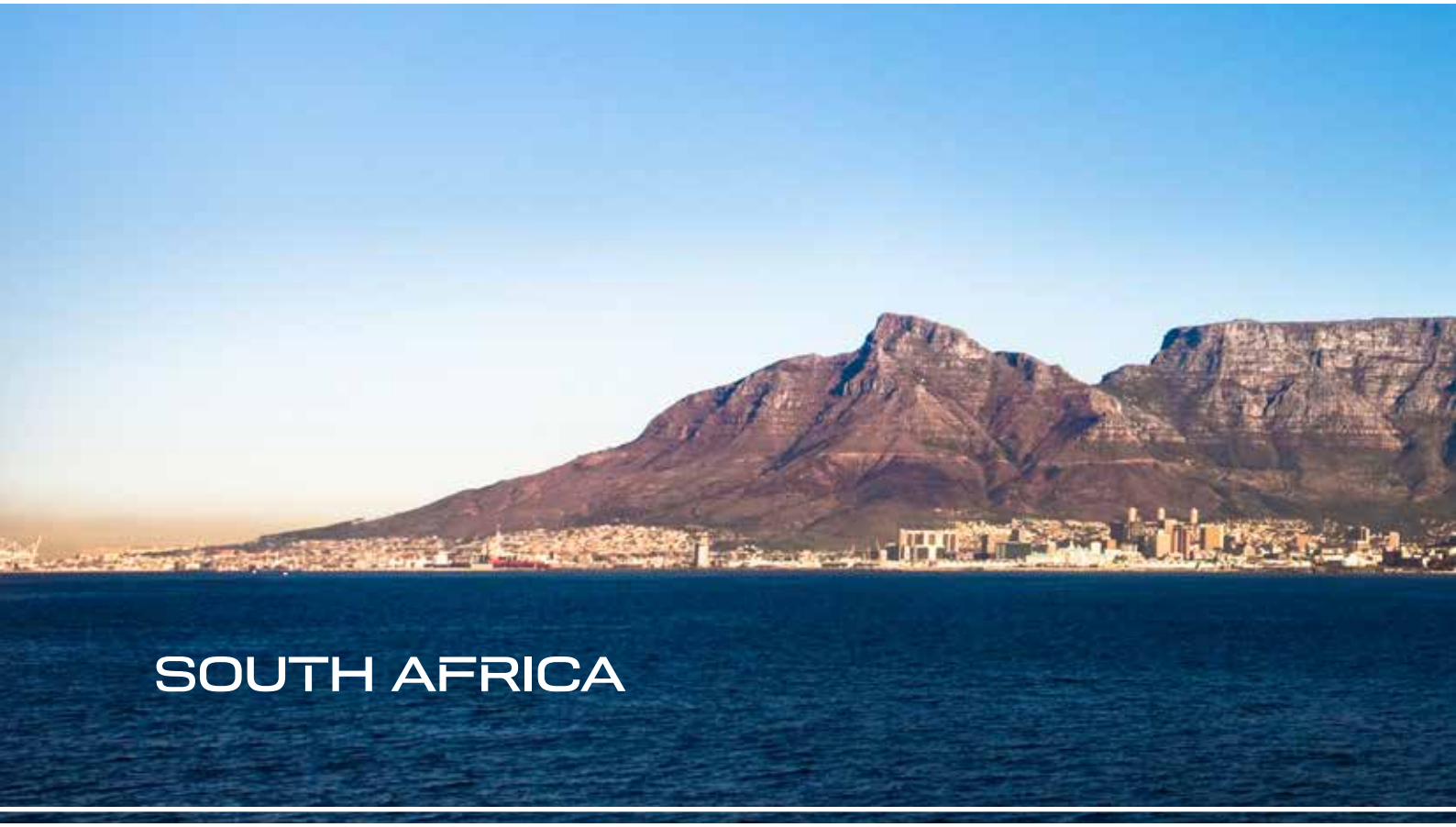
Based on these requirements, DNV GL has undertaken a series of country studies investigating these issues. The list of countries was discussed and agreed with ECI also taking into account data constraints. Per country an overview was given of the tariffs for typical consumer groups, the financial status of the utility and the network losses.

International best practice in generation and transmission expansion planning training workshop
Client: the regional power trade project, Nile basin initiative

The general objective of the training workshop was to expose participants to international best practices in generation and transmission system expansion planning techniques and methodologies, which ensure that an integrated power network can sustainably and cost effective meet the national and regional demands for power.
The training was based on the key aspects of integrated power system planning: policy and regulatory aspects, technical aspects, economic and financial aspects, and environmental aspects.

DNV GL delivered the training over a 5-day period. In particular the sessions of the workshop included the following topics:

- Industry and market organization, energy policy and regulation
- Investment appraisal, economic and financial analysis
- Demand forecasting and generation planning
- Hydro-modelling and hydro-planning process
- Transmission planning



SOUTH AFRICA

Basic environmental assessment for proposed wind monitoring masts
Client: Umoya Energy

Identification and assessment of environmental impacts associated with the establishment of wind monitoring masts at the proposed site of the Hope-field Wind Energy Facility, Western Cape Province.

The process was undertaken in accordance with the South African EIA legislation and included specialist studies (visual impact assessment) and public participation.

DNV GL provided the following services:
- Project management
- Authority consultation
- Public consultation
- Compilation of environmental reports (basic assessment report and environmental management plan)

Dynamic rating system for underground powe cable circuits
Client: The Cape Town City Council (CTCC)

CTCC requested DNV GL to install a Dynamic Rating System (DRS) for two underground power cables. DNV GL provided a detailed investigation of the most probable thermal bottlenecks along the cables' routes and a soil thermal resistivity analysis of these bottlenecks.

Also, a physical model of the thermal dynamic temperature response was developed representing the most severe thermal bottlenecks.
Calculation measurements verification ensured the reliability of the model and gave a solid foundation. The DRS thermal dynamical model is a valuable tool for the grid operator and the asset manager and it can be used to monitor the current and the predicted future temperature status of the cables.

Development of a secondary plant technology framework
Client: ESKOM

Due to the integration of parts of the T&D departments and the need for harmonization and standardization of policies, processes, and tools, ESKOM restructured its organization. Within this process an initiative was taken to develop a secondary plant technology framework for protection and control.

DNV GL supports ESKOM to develop such a framework. In order to do this, the project was divided in three tasks:

1. A detailed assessment of the situation of the Protection, Telecommunication, Measurement & Control(PTM&C). Performing site visits, interviews and workshops
2. Presentation of developments, such as IEC 61850, Cigré workshops and innovations by suppliers
3. Formulation of the PTM&C plant technology framework, strategy and roadmap and delivery of an extensive report

Engineering services for biomass co-firing options
Client: ESKOM

As Eskom depends on coal as its primary source of fuel power generation, it will diversify into biomass to reduce dependency and reduce carbon emissions. DNV GL assist Eskom with their goal to realise 10% of co-firing of biomass in the complete fleet by 2025. In 2012-2013 the following activities were performed:

- Techno-economic study of co-firing options, including torrefaction
- Specifications of raw biomass and torrefied products
- Prediction of effects of biomass co-firing on power plant performance
- Techno-economic evaluation of torrefaction technologies
- Description of a torrefied biomass co-firing test programme
- Evaluation of torrefaction technologies and developers
- Review of tenders and offers for torrefied biomass supply

Technical specifications review for supply chain effectiveness
Client: ESKOM

Eskom's goal is to create transparency and cost-effectiveness in its supply chain operations and to determine whether existing technical specifications meet current international standards for ESKOM supply chain executives, and if these specifications include any gold plating that could increase costs.

DNV GL made recommendations for:
- Improving transparency and cost effectiveness in supply chain operations
- Improving consistency in structure, format and content of technical specifications which would reduce engineering costs to develop and maintain specification
- Align specification to international standards, and to standardise on quality assurance requirements

Assessment of training and skills needs for the wind industry in South Africa
Client: Deutsche Gesellschaft für Zusammenarbeit GmbH (GIZ)

The German development agency GIZ selected DNV GL to assess the needs of the growing onshore wind industry in South Africa for training and skills development.

DNV GL carried out an initial estimate of the future needs for staff in three categories; skilled worker, technician and professional engineer.
This was founded on estimates of the growth of the wind industry in South Africa, including estimates of local turbine manufacture. The initial assessment was then used in a consultation process with a wide range of stakeholders in South Africa, including direct interviews, and industry workshops in Cape Town and Port Elizabeth. Stakeholders included wind project developers, turbine suppliers, component suppliers, education institutions and government departments.

The consultation process resulted in improved estimates of needs, which were compared with knowledge of existing training provision and the structure of the education sector, and used to produce recommendations for training needs in specific subject areas.

Lenders Technical Advisor (Wind, Solar PV and CSP)
Clients: Nedbank, Standard Bank, ABSA (Barclays), RMB, Investec, IDC, DBSA, EKF, Sumitomo, IFC

DNV GL has been actively supporting financial institutions as Lenders Technical Advisor for renewable energy projects developed under the REIPPP DOE framework in South Africa. DNV GL has advised on almost 1500 MW of renewable energy projects which have achieved preferred bidder status under this procurement programme. DNV GL provided advisory services in the following areas:
- Bankable energy assessments
- Technical due diligence
- Equator principles and IFC performance standard reviews
- Specialist technology reviews
- Detailed civil and electrical design reviews
- Inspection services (of manufacturing facilities and components)
- Construction monitoring

Power cable courses
Client: CBI Electric

DNV GL's power cable courses have been organized for multiple utilities and companies in South Africa. To meet the growing demand for training, DNV GL developed a series of power cable related courses, consisting of:
- A general three-day course on power cables in general
- Two-day courses on:
  - aging, quality assurance, testing, diagnostics and failures of power cables
  - ampacity and engineering aspects of power cables
  - asset management, maintenance and remaining life of medium voltage cables
  - asset management, maintenance and remaining life of high and extra high voltage cables

Wind energy: doing business in South Africa
Client: The Embassy of the Kingdom of the Netherlands

DNV GL was commissioned by the Netherlands Embassy in Pretoria, South Africa, to write an accessible document that would provide Dutch companies looking to enter the South African market, with a concise overview of the country's wind energy sector. The report covered all major issues affecting the South African wind sector, including an overview of the policies and government strategies influencing the development of the industry and provided projections for the likely growth of the sector in South Africa. It also contained an overview of the South African supply chain and mapped all major stakeholders involved in the national wind power industry. The work culminated in a high level analysis of the strength and weaknesses of the country's wind sector and highlighted potential opportunities for Dutch entrants. The work culminated in a presentation and workshop in the Netherlands, for Dutch companies.

Independent engineer under PPA
Clients: Eskom (Single Buyers Office), seven wind and solar project companies

DNV GL has been appointed as the independent engineer under the Power Purchase Agreement for five wind farm projects and two solar PV farms from Round 1 and 2 of the REIPPP. This role includes:

- Reporting on progress
- Signing off of the achieved capacity of each facility
- Signing off on the completion of the projects under the construction contracts

Feasibility study for a CSP plant in South Africa
Client: Mainstream Renewable Power

DNV GL carried out the independent energy production assessment for a proposed Concentrated Solar Power plant (CSP) of a 50 MW rated power, to be constructed in the centre of South Africa. The Client proposed the Parabolic Trough Collector (PTC) technology and DNV GL estimated the annual energy figures for two options: with and without thermal energy storage.

Solar PV Measurement Campaign Specifications and Independent Energy Production Assessment for several sites in South Africa
Client: Mainstream Renewable Power

DNV GL was appointed as the technical advisor to develop a Solar PV Measurement Campaign Specifications and subsequent Energy Production Assessment for three proposed solar PV projects to be delivered under the 1st Round of the REIPPP programme.

DNV GL used the on-site measurement data to undertake an Energy Production Assessment for the Projects. Two of them were selected in the first round of the REIPPP programme.

Employer's requirements for 2 PV plants in South Africa
Client: Confidential

The clients were looking to develop 2 PV plants in South Africa for the round one of the IPP Procurement Programme announced by the Department of Energy in South Africa.

DNV GL was appointed as owner´s engineer to prepare technical specifications for an EPC and O&M contract. The specifications included the EPC contract for the design, supply and installation of the equipment and the ongoing operation and maintenance (O&M) of the equipment.

Project construction monitoring for two CSP projects in South Africa
Client: EIG Global Energy Partners

DNV GL analyses the information provided by Project Sponsor related to the Project construction progress in order to issue a monthly monitoring report for the client. Among others DNV GL analyses project budget, construction schedule and milestones, technical issues, quality and environmental issues and potential project risks.

Technical Due Diligence for two PV plants of 75MW each in South Africa
Client: Confidential

The Client was acting as debt provider, active in the development and financing of several photovoltaic (PV) projects to be submitted for round two of the IPP Procurement Programme announced by the Department of Energy in South Africa.
DNV GL was appointed as the Lender's Technical Advisor for two solar PV plants planned in the Northern Cape and Western Cape regions in South Africa. The Projects had a proposed installed capacity of 27 MWp. As part of the tasks undertaken, DNV GL has performed the site assessment, independent energy production assessment, review of Projects design and techno-logy evaluation, contractual review, evaluation of the technical inputs on the financial model among other activities.

Technical Due Diligence for two projects in South Africa
Client: EIG Global Energy Partners

DNV GL analysed of the technical feasibility and economic profitability of two CSP Projects in South Africa. Technical due diligence reports, Energy Resource Assessment, Project design information, DoE requirements compliance, Project Agreements and Environmental compliance and Project permitting has been some of the information reviewed by DNV GL.

Technical Due Diligence for one CSP project in South Africa

Client: Old Mutual Investment Group

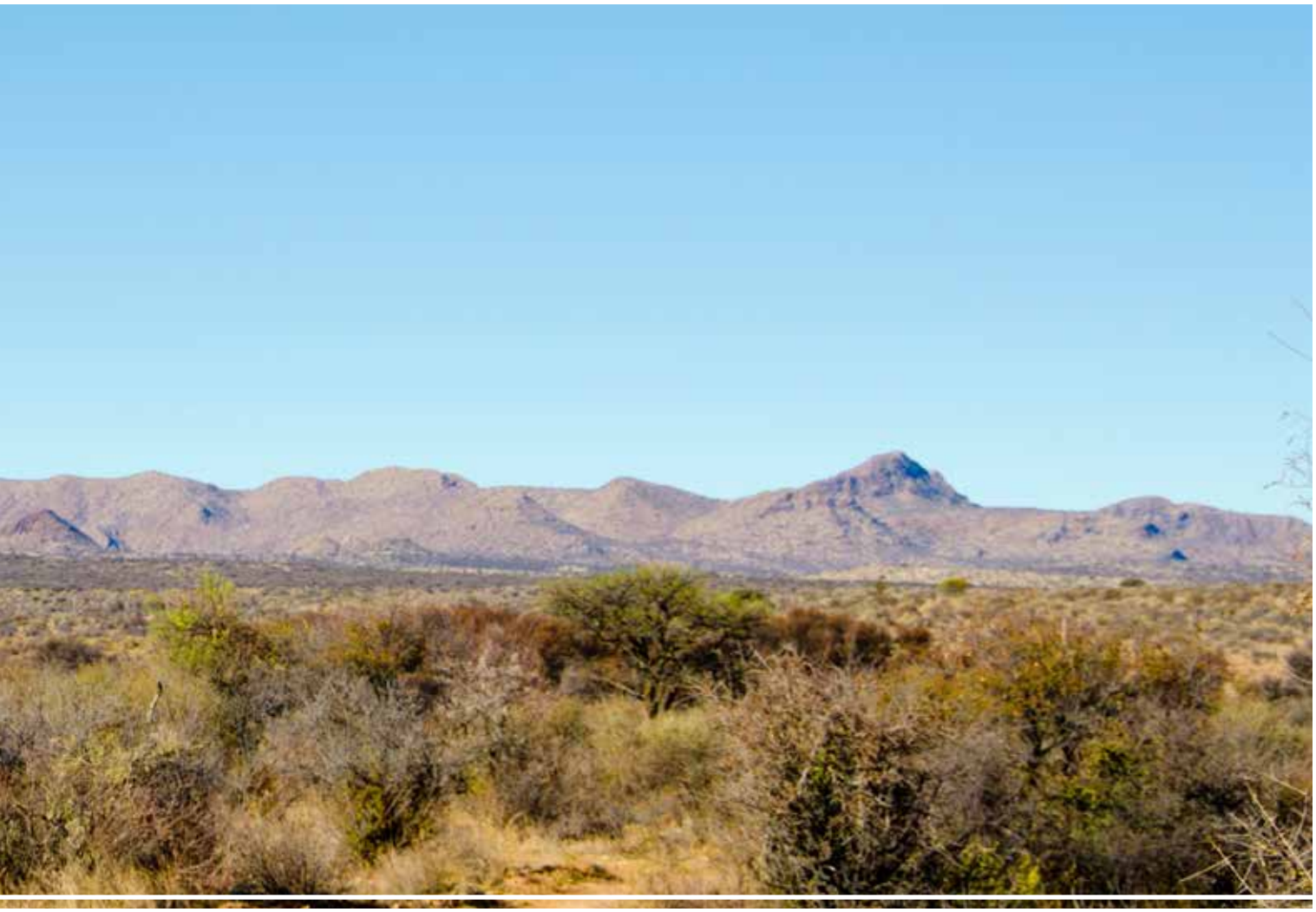
DNV GL carried out a technical review of the Bokpoort 50MW Concentrated Solar Power (CSP) plant, to be installed in South Africa. The client provided technical, contractual and regulatory documentation of the project which was reviewed and evaluated by DNV GL. A Site Visit was performed in order to deepen the insight into project feasibility.

Lender's Technical Advisor for a 94 MWp solar PV plant using one axis solar trackers

Client: Confidential

DNV GL was appointed as the Lender's Technical Advisor for one of the biggest solar PV Projects in South Africa in the 2nd Round of the REIPPP programme.
As part of the tasks undertaken, DNV GL has performed the independent energy production assessment making use of onsite measured data, evaluation and lender's support during the contract negotiation, evaluation of the technical inputs on the financial model among other activities.

As part of the agreement, DNV GL undertakes the construction monitoring on behalf of the lenders.



LESOTHO

Measurement campaign design
Client:
Confidential

The client developed a wind farm in Northern Lesotho and contracted DNV GL to provide technical services in support of conducting a monitoring campaign.

DNV GL provided technical advisory services to the client in order to assist in the design of a meteorological campaign. This involved a detailed review of the topographic conditions at the site, the identification of optimal locations for meteorological equipment and the specification of financial requirements for such equipment.

NAMIBIA

Development of an electricity support tariff mechanism
Client:
Namibian Government

The Namibian Government has invested significantly in rural electrification to increase access to electricity. Higher electricity prices however, will undermine the government's plan to extend the benefits of electricity to all people in Namibia, mainly because electricity will become an unaffordable commodity to most of the poor communities. This would have a major detrimental impact on the socio-economic developments and long term growth prospects of the country. It is therefore imparitive that a solution should be found to make electricity more affordable to poor consumers in Namibia and to cushion them against rising electricity prices.

DNV GL investigated the need for and the possibilities for the implementation of an electricity support tariff mechanism in Namibia and if so, how it should be executed.

As part of the project the regional and international options for the introduction of a support mechanism tariff to shield poor households against rising electricity prices were investigated. The strengths and weakness of the different options were discussed and recommendations were made based on the most appropriate support mechanism tariff for Namibia.

MOZAMBIQUE

Tariff methodology for the piped gas industry

Client:
Ministry of Mineral Resources (MIREM)

Given the significant gas resources in Mozambique, a further development of its gas sector could provide significant sources of revenues for the country and contribute to economic development and progress. In order for Mozambique to develop a domestic gas market and to sell more gas to its neighboring countries, further investments in the gas infrastructure are needed, especially in the gas transportation pipelines.

DNV GL was engaged to provide advice to the Ministry of Mineral Resources (MIREM) on outlining the Government's approach regarding a gas transportation tariff methodology in Mozambique including advice on tariff setting, implementation and monitoring and to provide training to stakeholders on the approach and rationale for determi-ning a transportation methodology.

Gas based industry feasibility study in the sadec region

Client:
African Development Bank

By order of the African Development Bank the technical and commercial feasibility of a gas based industry in the SADEC region, in particular Angola and Mozambique, has been studied in the first half of 2013.
One of the priorities of the governments of Angola and Mozambique is to set up value added industries based on the resource of natural gas. Our study will assist different stakeholders to make optimal decisions.
The study focuses on the following seven potential products based on gas: LNG, gas-to-liquids, power generation, fertilizer, methanol, metal smelter and cement industry. For each of these seven products the technical and commercial feasibility has been assessed. Within these assessments the price and volume outlook for the next decade has be provided, the regulatory and legal framework has been commented and the potential contribution of SME (small and medium enterprises) has been evaluated. The study has made a recommendation for a portfolio of gas based industrial projects for Angola as well as Mozambique which can assist the governments in pursuing their gas based industrialization policies with maximum value addition for the respective countries. The final report of the study has been delivered in June 2013.

TANZANIA

Support services during repair & refurbishment work on gas turbines

Client:
Songas Limited

Damage occurred to several components of two gas turbines of the Songas Ubungo CCGT power plant. Songas requested DNV GL to provide the services to investigate this unexplained damage by reviewing GE's Root Cause Analysis (RCA) work. The services will concentrate on the LPT section damages. Other damages will be briefly reviewed during the workshop visits. DNV GL's scope of services included:

- Two visits to the GE Rheden (the Netherlands) maintenance depot to view engine disassembly and to review and discuss findings
- A review of the GE RCA failure investigation and analysis, including recommendations to prevent a reoccurrence which will be documented in a written report
- Advice on any warranty matters and/or repairs proposed by GE
- Assistance with other related matters that may come up as agreed to by both parties
- Preparation of a summary report

Project progress review

Client:
FMO, Entrepreneurial Development Bank

FMO invested in a rural electrification project in the Mtwara region called the Mtwara Energy Project (12 MW power plant and distribution network). The Mtwara region is situated in the southeastern part of Tanzania. Before taking further steps in the project, FMO required a technical review to ensure the technical feasibility and status of the project.

The scope of services by DNV GL included a high level review of the project organization, the technical feasibility and engineering documents. The review consisted of a technical audit on the power plant, giving an indication whether the size of this plant was sufficient to supply the required energy to the customers. As a second stage in the project, DNV GL also performed a budget review.

Review of root cause analysis investigations

Client:
Globeleg Inc.

The Ubungo power station is part of Globeleq's/ Songas gas-to-power project which brings natural gas to Dar-es-Salaam, the capital of Tanzania, through a 225 kilometer pipeline from the Songas gas processing plant on Songo Songo Island. In February 2008 a major damage was found on the compressor of Ubungo GT1. During subsequent inspections additional damages were found to blades and vanes of the compressor turbine and the power turbine, of both GT1 and GT2.

Siemens started two Root Cause Analysis (RCA) processes:

- To identify the root cause for the GT1 compressor damage
- To find the root cause for the damages (cracking) of the turbine blades and vanes of both GT1 and GT2

Both GT1 and GT2 are Siemens gas turbines type SGT-600 (GT10B). On behalf of Globeleq/Songas DNV GL reviewed the RCA findings from Siemens. As a part of this review a site inspection has been carried out. During the investigation a progress meeting at Finspong was held.

Pre-construction project development services for the proposed Singida wind farm
Client:
Aldwych International

Wind East Africa, a consortium comprising Six Telecoms of Tanzania, Aldwych International Ltd. of the UK, and the IFC-Infra Ventures of the World Bank Group, is developing the Singida Wind Farm, which has a proposed total capacity of approximately 100 MW and is located 10 km southeast of the town of Singida, Tanzania.
Aldwych International Ltd. (the client) has contracted DNV GL to provide a range of project development support services including:

- Preliminary wind mapping
- Measurement campaign recommendations
- Wind farm layout design
- Full energy production assessments
- Wind farm moise modelling
- Wind farm power time series derivation
- Wind farm power forecasting analysis

ZAMBIA

Renewable energy resource mapping: wind
Client:
World Bank/Zambia Department of Energy

The Zambia wind project (awarded to DNV GL in April 2014) is funded under the World Bank Energy Sector Management Assistance Program (ESMAP) to quantify renewable energy resource in various developing countries. The overarching goals of this initiative are to develop sustainable energy infra-structure, stimulate economic growth and ultimately reduce poverty.

The Scope of the three year Zambia project will consist of mesoscale wind mapping for the entire country, a comprehensive 2-year ground-based measurement campaign, and a fully validated micro-scale wind resource map. This will provide Zambia with its first comprehensive wind resource atlas, enabling policymakers to formulate informed decisions about future energy infrastructure development.

Throughout the project, DNV GL will be engaging directly with local governmental and private sector stakeholders to educate them on renewables development, and help initiate a new and vibrant industry within the country. A number of in-country workshops and knowledge transfer activities will be delivered throughout the project.

This work will involve DNV GL experts from the US, Canada, South Africa, UK and Denmark.

SAFER, SMARTER, GREENER

KEMA Nederland B.V.
Utrechtseweg 310
6812 AR Arnhem, the Netherlands
Tel: +31 26 356 9111
Fax: +31 26 443 4025
www.dnvgl.com/energy
contact.energy@dnvgl.com
Registered Arnhem 09080262

DNV GL
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries.

Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. With our origins stretching back to 1864, our reach today is global. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping customers make the world safer, smarter and greener.

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