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CSP TECHNOLOGY OVERVIEW
NAMIBIA SOLAR RESOURCE AND DNI ANALYSIS
ENVIRONMENTAL ANALYSIS AND SITE SELECTION
TOP 5 SITES SELECTION AND GROUND MEASUREMENTS
FINANCIAL ANALYSIS AND CSP BUSINESS MODEL
CSP DEVELOPMENT AND IMPLICATIONS FOR NAMIBIA

Capacity building roadmap & Technology transfer program

Table of contents

- Introduction
- Characterization of Namibian scientific and education sector
- Characterization of Namibian industry players relevant for CSP
- Required skills for CSP development in Namibia
- Academic skills assessment and main gaps

- Long term goal: Increase baseload power capacity
 - Some CSP technologies have the advantage that energy can be stored for currently up to 15 hours
 - Such a CSP plant can be regarded as a form of baseload power plant, especially when hybridized
- Installation of new technologies requires important steps to be performed in the field of education and the involvement of industry
- Educational aims
 - Establish capacity building program according to the requirement for planning, construction and operation of CSP plants
 - Extensive knowledge is required for independent R&D activities
- Aims regarding industry
 - Promote local industry in required fields of work at CSP plants
 - Development of local industry has a positive effect on economy of Namibia

- Questions related to the project
 - What is the quality of higher education in Namibia?
 - Do higher education CSP related programs exist?
 - Does local industry have the skills and expertise to perform or participate in the construction, operation and maintenance of a CSP plant?
 - How can educational and industrial capacity building be best achieved?
 - How can identified gaps be best counteracted?

Namibian scientific and education sector structure

- Higher education

In Namibia, there are two main scientific institutions that are engaged in renewable energies

- University of Namibia (UNAM)
- Polytechnic of Namibia (Polytec)
 - Renewable Energy and Efficiency Institute (REEEI)

Namibian scientific and education sector structure



- University of Namibia (UNAM)
 - Main campus in Windhoek, ten additional campuses in Namibia
 - Core competences:
 - Faculties: agriculture and natural resources, economics and management science, education, engineering, information technology, and others
 - Schools and Centers: veterinary sciences, pharmacy and health science
 - Workshops are performed in research policy and institutional research strategy implementation
 - A faculty for renewable energy topics is located in Ongwediva and was founded in January 2008
 - UNAM conducts capacity building, but not in the field of renewable energy and/or sustainable energy. This would have to be established

Namibian scientific and education sector structure



- Polytechnic of Namibia (Polytec)
 - Main campus in Windhoek
 - Core competences (schools): Management, engineering, health and applied science, humanities, information technology, natural resources and tourism
 - Largest faculty is School of Business and Management (70% of the students), followed by the School of Engineering with just under 10% of the students
 - Focus in the field of renewable energies is on
 - Solar home systems
 - Feasibility studies for the utilization of wind generators
 - analysis of new technological approaches

Namibian scientific and education sector structure



- Polytechnic of Namibia (Polytec)
 - Capacity building takes place within the Renewable Energy and Energy Efficiency Institute (REEEI)
 - The REEEI as an institute affiliated to the Polytec is the main knowledge source for renewable energies
 - The Aachen University of Applied Sciences (AcUAS) is one of more than 10 German universities cooperating with the Polytechnic of Namibia

Namibian scientific and education sector structure

- Renewable Energy and Energy Efficiency Institute (REEEI)
 - REEEI is affiliated to the Polytechnic of Namibia
 - Main activities: Establishment of a national information resource base for renewable energy, sustainable energy use and its management
- Current projects
 - NEEP: Project's main focus is energy efficiency improvement in buildings. Aim is to reduce green house gases by means of optimizing processes in buildings, as well the reduction of electric energy consumption
 - REEEI launched master plan for the provision of electricity in off-grid areas by the establishment of so-called Energy Shops
 - SOLTRAIN: Promotion of renewable energies in South Africa, Namibia, Mozambique and Zimbabwe by means of training and capacity building and the implementation of small and medium enterprises
 - The project "Energy regulatory framework for Namibia" aims to establish renewable energy sources in Namibia and strives to promote them with a feed-in tariff for private and/or commercial energy producers
- The REEEI is the first point of contact regarding CSP promotion in Namibia

Namibian scientific and education sector structure

- Problems regarding the educational structure in Namibia
 - The educational level in Namibia's secondary seniors is still low compared to students from southern or eastern African countries
 - Problems arise from students' and lecturers' side
 - Students
 - Often have a lack in language skills
 - Low level in mathematics and natural sciences
 - important to reduce these deficits
 - Lecturers
 - Universities are facing the problem to find and hire qualified lecturers and professors
 - Primary and secondary levels are well distributed in the country, but higher education mainly takes place in Windhoek

Characterization of Namibian industry players relevant for CSP

- Involvement of local and nationwide industries for the possible construction of CSP plants is indispensable for the project goal
- Investigation and inclusion of national industry partners a win-win situation
 - Local industry may benefit from possible orders
 - Opportunity to increase knowledge on manufacturing processes
 - Local and nationwide industry may experience a long-term growth induced by sustainable and successful establishment of renewable energies
- Foreign companies might be involved in the processes as well
 - Specialized companies may gain ground in the growing markets of Namibia
 - Can provide know-how and consultancy services on the basis of partnerships
- Existing economic incentives may have positive effects
 - Remission of corporate income taxes (up to 50%)
 - Exemption of value added taxes
 - Discounts in transportation sector (up to 25%)

Characterization of Namibian industry players relevant for CSP

- Many company profiles are not present
 - Detailed information on these particular companies, their experience and product portfolio is scarce
- There are deficits where local companies cannot meet the requirements
 - Suitable companies from foreign countries will have to be chosen to fill the gap
 - The planning would include local and nationwide Namibian as well as foreign companies
 - Namibian companies should be involved with preference

Characterization of Namibian industry players relevant for CSP

Area of activity selected	CSP Technology			
	Parabolic trough	Linear Fresnel	Power towers	Stirling Engines
Glass	Parabolic mirrors	Flat mirrors	Flat mirrors	Flat mirrors
Mechanical steel foundations, concrete	Collector frames	Collector frames	Trackers structures, Tower	Dish frames, Trackers structures
Normal steel pipes	Evacuated tubes	Normal pipes, Evacuated tubes	Cavities piping	Stirling Engines
Water treatment system	Water treatment plant	Water treatment plant	Water treatment plant	
Conventional cycle	Steam cycle, pressure vessels	Steam cycle, pressure vessels	Steam cycle, pressure vessels	
Instrumentation and control	Tracking algorithm, steam generation	Tracking algorithm, steam generation	Tracking algorithm, steam generation	Tracking algorithm
Electric power to grid	Power generation	Power generation	Power generation	Power generation

Characterization of Namibian industry players relevant for CSP

- Generally the following industries are considered:
 - Glass industry
 - Steel and concrete industry
 - Mechanical structures industry
 - Pressure vessels
 - Turbine manufacturers
 - Piping and pumps
 - Instrumentation and control
- Additionally the following services were considered
 - Ancillary services
 - Engineering services
 - Financial services sector

Characterization of Namibian industry players relevant for CSP

Companies	CSP area
Valco Sales & Service CC	pumps, fittings, heat transfer, heat exchangers
Nirosta	Steel, pressure vessels
Pupkewitz Metalworx	very large group of companies, may be able to supply components
Kurose (Pty) Ltd	water, heat exchanger, pipes, tanks
Ohorong Cement (Pty) Ltd	foundations
RMB bank	CSP experience in SA
PG Glass	tempered glass
Africa Glass Industries Namibia	Not clear whether they manufacture tempered glass
Burbridge Glass CC	Not clear whether they manufacture tempered glass
Suremix	Foundations
Brick & Concrete Industries (Pty) Ltd	Foundations
City Concrete (Pty) LTD	Foundations
Concretech industries	Foundations
Concrete-Simply In	Foundations
NAMSLAB	Foundations
COASTAL PRECAST & PAVING	Foundations
WIBEKU CC	Foundations
Deamaru Group CC T/A Desert Iron & Steel	Steel structures
Kraatz Steel (Pty) Ltd	Steel structures
Steel & Industrial Supplies	Steel structures

Characterization of Namibian industry players relevant for CSP

Companies	CSP area
Namibia Engineering Corporation	Steel structures
Pro-Edge Steel	Steel structures
Coastal Steel Works	Steel structures
Okahandja Wire & Steel	Steel structures
Stainless Engineering	Steel structures
Exacto Engineering CC	Steel structures
Invo Stahlbau CC	Steel structures
Steel & Wire	Steel structures
Steel Force CC	Steel structures
Suresteel	Steel structures
Steeldale Reinforcing & Trading (Namibia)	Steel structures
Aurecon	Engineering
Burmeister & Partners	Engineering
EMCON	Engineering
CSA	Engineering
CMB Namibia Ltd	Engineering
Precast Walls	Foundations
Namibia Garden & Cement Product CC	Foundations
Coupar Contrete (Pty) Ltd	Foundations
SONnex Precast Concrete Industries	Foundations
Barloworld Concrete Industries	Foundations

Characterization of Namibian industry players relevant for CSP

- Glass industry
 - Established on a low industrialized level
 - Main focus: window glass, glass for winter gardens, car glass
 - In 1999 the governments of the Czech Republic and the Republic of Namibia started cooperation which aimed to prepare a geological survey and to promote the build-up of glass industry in Namibia
- Tempered glass is offered by the companies
 - PG glass
 - African glass
- Improvement requirement in this sector for CSP
 - High

Characterization of Namibian industry players relevant for CSP

- Mechanical structures industry
 - Most machinery imported (>2/3 from South Africa)
 - Companies located in Windhoek offer mechanical and structural services
 - 3 companies have references in different fields of work,
 - e.g. power generation transmission and distribution, transportation systems and logistics as well as renewable energy systems
 - Experience in building sciences, structures, business advisory, water management and treatment
 - Companies can design metallic structures and manufacture steel
- Companies
 - Aurecon
 - Brumeister & Partners
 - CMB Namibia Ltd.
- Improvement requirement in this sector for CSP
 - Medium to high

Characterization of Namibian industry players relevant for CSP

- Pressure vessels
 - Companies producing pressure vessels and other parts for power plant components are very rare
 - Some could operate as a supplier of some of the components
 - Only one is able to act as a big player
- Companies
 - Nirosta
- Improvement requirement in this sector for CSP
 - Too specific to build up this industry sector

Characterization of Namibian industry players relevant for CSP

- Turbine manufacturers
 - No Namibian turbine manufacturers exist
 - Global players have offices in the country
- Companies
 - Siemens
 - Alstom
- Improvement requirement in this sector for CSP
 - Too specific to build up this industry sector

Characterization of Namibian industry players relevant for CSP

- Tube constructors
 - Expertise is available
 - Several other smaller companies were identified but could not be investigated in detail due to lack of information
- Companies
 - Ecotech
 - Atlantic Industrial Trading, Elwiwa, Valco Pipes, Tenner Meters, Petzetakis SA
 - Afrox
- Improvement requirement in this sector for CSP
 - Low to medium

Characterization of Namibian industry players relevant for CSP

- Piping and pumps
 - Industrial water pumping is available
 - Several small water pumping companies exist but cannot handle large scale applications
 - Most companies sell small pumps for private purposes
 - A large company offers high quality water services and turnkey solutions
- Companies
 - Valco Sales & Service CC
 - Nirosta
 - Pupkewitz Metalworx
 - Kurose (Pty) Ltd
 - Afro Pumps & Metalcraft
 - Warman Namibia
 - DIS Engineering
- Improvement requirement in this sector for CSP
 - Medium to high

Characterization of Namibian industry players relevant for CSP

- Water treatment
 - Only one specialized water treatment company provides high quality water services and turnkey solutions
- Companies
 - Aqua Services & Engineering (Pty) Ltd
- Improvement requirement in this sector for CSP
 - High

Characterization of Namibian industry players relevant for CSP

- Engineering services
 - Large number of consulting engineering firms exist
 - Organized in the Association of Consulting Engineers of Namibia (ACEN)
 - General engineering consulting
 - Provision of tooling equipment, boring machines, valves etc.
 - Several smaller welding and CNC services
- Companies
 - Aurecon, Burmeister & Partners, EMCON, CSA, CMB Namibia Ltd., Meyer Consulting Engineers, Lithon Project Consultants, Windhoek Consulting Engineers (WCE), Danie Nel Consulting, Corona Consulting
- Improvement requirement in this sector for CSP
 - Low

Characterization of Namibian industry players relevant for CSP

- Burner developers
 - No companies could be identified
- Companies
 - None
- Improvement requirement in this sector for CSP
 - Too specific to build up this industry sector

Characterization of Namibian industry players relevant for CSP

- Instrumentation and control
 - One company could be identified
- Companies
 - Ecotech (Ecogroup - Windhoek Head Office)
- Improvement requirement in this sector for CSP
 - Medium to high

Characterization of Namibian industry players relevant for CSP

- Steel industry
 - Steel production is well covered
 - Several companies are specialized in trading of discarded metal from the surrounding countries
- Companies
 - Kraatz Steel (Pty) Ltd., Namibia Engineering Corporation, Pro-Edge Steel, Coastal Steel Works, Stainless Engineering, Exacto Engineering CC, Invo Stahlbau CC, Steel & Wire, Steel Force CC, Suresteel, Steeldate Reinforcing & Trading (Namibia)
- Improvement requirement in this sector for CSP
 - Low to medium

Characterization of Namibian industry players relevant for CSP

- Concrete industry
 - Concrete production is well covered
 - Many firms are specialized in foundations
 - Two firms are able to construct larger projects, e.g. construct multi-purpose buildings
- Companies
 - Ohorongo Cement (Pty) Ltd., Suremix, Brick & Concrete Industries (Pty) Ltd., City concrete (Pty) Ltd., Concretech industries, Concrete Simply In, NAMSLAB, Coastal Precast & Paving, Wibeku CC, Precast Walls, Coupar Concrete (Pty) Ltd., Barloworld Concrete Industries
- Improvement requirement in this sector for CSP
 - Low to medium

Characterization of Namibian industry players relevant for CSP

- Ancillary services
 - In 2005 the Namibian Electricity Control Board published *The Namibian Grid Code*
 - System operator holds responsibility for technical specification and carrying out of all short term (daily) reliability services necessary for interconnected power system
 - Ancillary services: operating reserves, black start and islanding, regulation and load following and near 50 Hz resonance control service etc.

Characterization of Namibian industry players relevant for CSP

- Ancillary services
 - Amount of electrical power imported by Namibia is about the same as it produces
 - Most of the imported power is supplied by Eskom, a South African electricity public utility, and the balance is supplied by Zambia Electricity Supply Corporation Limited (ZESCO)
 - A recent newly negotiated contract with Eskom no longer guarantees Namibia firm power supply and due to increased power demand by South Africa in the coming years, Eskom may no longer export the electricity to Namibia in the future
 - Namibia will face a power deficit of 80 MW in winter 2012 which is expected to increase to 300 MW by the end of 2015
 - Nampower wants to commission a new baseload power plant in Namibia by 2016
 - Until Namibia largely increases its own power generation capacity, ancillary services are likely to have to be requested from abroad in order to compensate the power grid fluctuations as Namibia produces only baseload
 - Difficult to foresee

Characterization of Namibian industry players relevant for CSP

- Financial services
 - Several banks provide services and special offers for small and medium enterprises (SMEs)
 - Bank Windhoek Ltd.
 - Financed 34 SMEs through a dedicated ESME branch (N\$ 20 million in loans)
 - Start-up business financing for Namibian residents with a loan requirement between N\$ 150,000 and N\$ 2.5 million
 - First National Bank (FNB)
 - Offers standardized financing packages and financing for more complex buy-in and buy-out transactions
 - Financing by term loans, asset based finance and/or overdraft facilities
 - Loans for start-ups, expansion, management buy-outs and management buy-ins
 - Nedbank
 - For clients with an annual turnover between N\$ 5 million and N\$ 100 million

Characterization of Namibian industry players relevant for CSP

- Financial services
 - Standard Bank's
 - Orientates at project finance deals above US\$ 10 million
 - FIDES Bank Namibia
 - Microfinance bank
 - Probably not suitable for large projects
 - Development Bank of Namibia (DBN)
 - Finance for private sector start-ups and expansions as well as small and medium enterprises etc.
 - Loan span: N\$ 150,000 to N\$ 3 million
 - Corporate clients in particular branches (manufacturing, mining, tourism, etc.) has a loan span of N\$ 3 million to N\$ 120 million under equal conditions
 - Additional support by the DBN to small and medium enterprises clients, which includes training, mentoring, monitoring and evaluation

Required skills for CSP Development in Namibia

- Temporary and permanent jobs are created during construction and operation of a plant
- Required skills in welding, mirror fixing, optics measurement and others
 - Skills will be enhanced during construction phase and will sustain in the Namibian society
- Maintenance and plant operation jobs will be created for engineers as well as technicians

	Parabolic trough (20 plants* chosen for calculation)	Power towers (5 plants** chosen for calculation)		Parabolic trough, in operation (10 plants were chosen for the calculation)	Power towers, in operation (2 plants were chosen for the calculation)
Average construction job-years per MW _e (gross)	8.2	7.1		11.3	37.3
Average annual O&M jobs per MW _e (gross)	0.5	0.6		0.7	2.3

*Operational, under construction, under development and under contract.

**Operational, under construction and under development.

Required skills for CSP Development in Namibia

- R&D support should be given to start-up CSP companies
 - Research results could be turned into products
- REEEI to build up CSP research
- Capacity build up: research facility with lab scale components (e.g. heat collector elements, heliostats or a section of a trough or Fresnel reflector)
- Extension of cooperation with research institutions and universities -> guest professors from abroad (e.g. SIJ, DLR)
- Student exchange programs with foreign universities

Required skills for CSP Development in Namibia

- Equipment certification in Namibia by
 - South African Bureau Standard (SABS)
 - American National Standards Institute (ANSI)
 - ANSI is introducing its standards to Europe, Middle East & Africa as a part of a Regional Standing Committee (RSE EMEA)
 - Namibian Standards Institution (NSI)
 - Responsibility in developing, adopting and applying standards
- Standards are often not followed stringently by many smaller companies
 - Most of these companies apply a rule of thumb

Required skills for CSP Development in Namibia

- Requirement for operation and maintenance
 - Safety instructions (HTF, pressurized systems, concentrated solar radiation)
 - Know how to repair/maintain broken solar field components (heat collector elements, mirrors, tracking motors, electronics...) and some power block components (gauges, valves...)
 - Operation of power block and the plant components from the process control system
 - etc.

Required skills for CSP Development in Namibia

- Academic skills assessment and main gaps identified
 - Highly diversified educational environment covering important engineering disciplines
 - Existing knowledge in renewable energies located particularly in REEEI
 - REEEI has no CSP related topics
 - For the establishment of a new CSP market a training and capacity building program should be set up

An aerial photograph of a concentrated solar power (CSP) plant during sunset. The sun is low on the horizon, creating a bright, glowing lens flare that illuminates the scene. The plant consists of a large field of heliostats (mirrors) arranged in a grid, reflecting the sun's light. The surrounding landscape is a mix of green fields and brown, plowed earth, with distant hills visible under a hazy sky. The overall atmosphere is warm and golden.

Thank you for your attention!