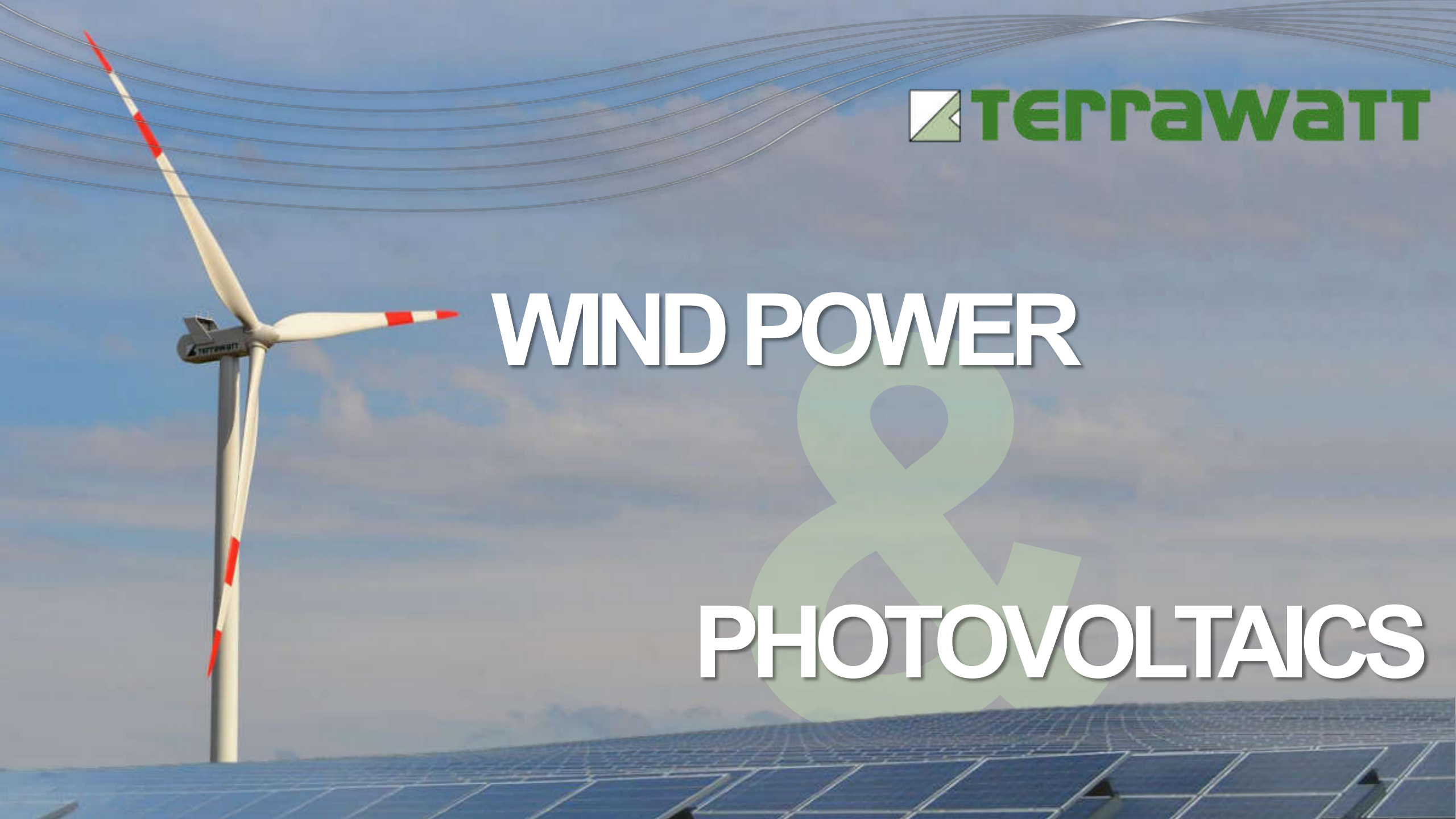




WIND POWER

PHOTOVOLTAICS



CONTENT

BRIEF COMPANY PRESENTATION

EXPERIENCES IN AFRICA

PRESENTATION KATSINA WIND FARM

PRESENTATION ASHEGODA WIND
FARM

PRESENTATION SOLAR SYSTEM
NAMIBIA

COMPANY PRESENTATION

- **FOUNDATION**

1996 in Grimma, Germany.

- **CORPORATE PURPOSE**

Planning, consulting and installation of electrical equipment for the usage of renewable energy.

- **THE TEAM**

Our team consists of engineers with diverse specialties (environmental, mechanical, electrical and civil engineers), planner and land surveyor.

Because of our long experiences and profound technical knowledge, the projects can always be implemented professional and on schedule.

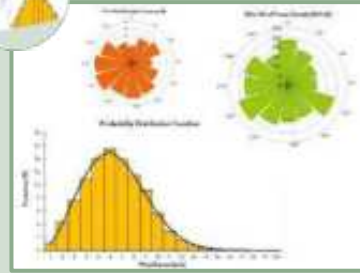
SERVICES ONSHORE



SITE EVALUATION



SECURING SUITABLE
LOCATIONS



ENERGY YIELD
ASSESSMENTS



MICROSITING &
TECHNICAL DESIGN



CONSENT PROCESS



GRID CONNECTION
CONCEPT



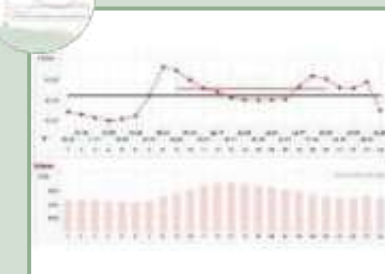
PROJECT FINANCING



CONSTRUCTION SUPERVISION
& COMMISSIONING



OPERATION &
MAINTENANCE



POWER
COMMERCIALISATION



TERRAWATT

SERVICES OFFSHORE



**SUPPORT
PRE-ASSEMBLY SURVEY**



QUALITY ASSURANCE



**OFFSHORE WORKS
CONSTRUCTION SURVEILLANCE**



TERRAWATT

REFERENCES

WORLDWIDE PROJECTS

31 countries

more than 300 Projects

≈ 2.700 WTGs

≈ 6 GW (installed capacity)



TERRAWATT

Involvement in Africa

AFRICA

NIGERIA

Katsina 10.2 MW

Owners engineer for the first wind farm in Nigeria

MAROCCO

Haouma 80 MW

Feasibility study civil & electrical engineering

Several Projects 850 MW

Grid calculation and optimization

ETHIOPIA

Ashegoda 120 MW

Design Review and construction supervision for electrical works

EGYPT

BOO Wind Power Project 250 MW

Preparation of tender documents for electrical part & cable routing



TERRAWATT

MAROCCO

EGYPT

ETHIOPIA

NIGERIA

NAMIBIA

RES Project Namibia

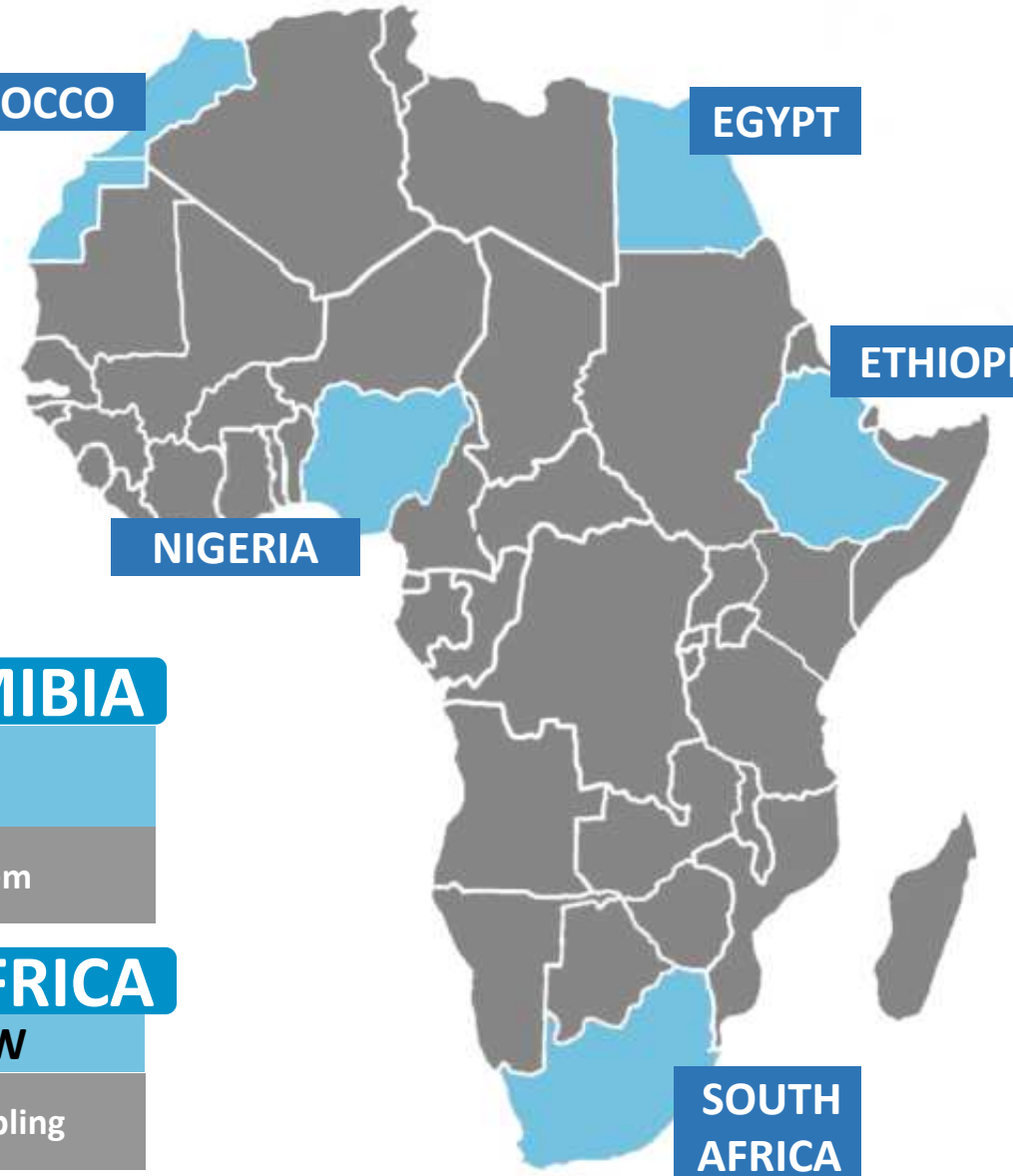
Commissioning of Solar System

SOUTH AFRICA

Several Projects 800 MW

Grid Calculation and external cabling

SOUTH AFRICA



Presentation

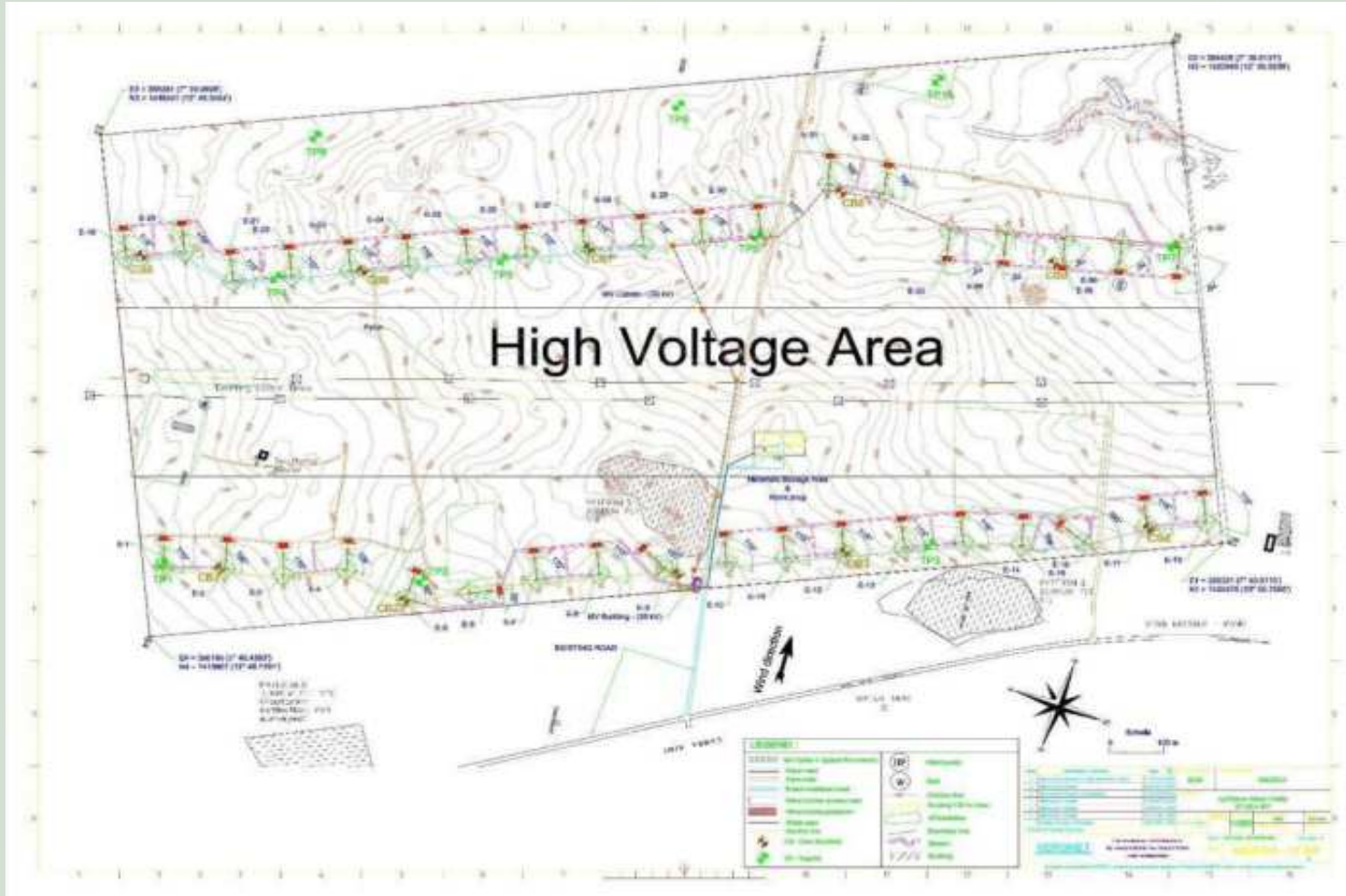
Katsina Wind Farm

Nigeria

Katsina WF



Location:	Northern Part of Nigeria / Border to Niger
Rated Power:	10 MW
Number of WTG:	37
Power of each WTG:	275 kW
Turn Key Contractor And Turbine Supplier:	Vergnet S.A. / France
Project Consultant:	Terrawatt Planungsgesellschaft mbH / Otis Engineering



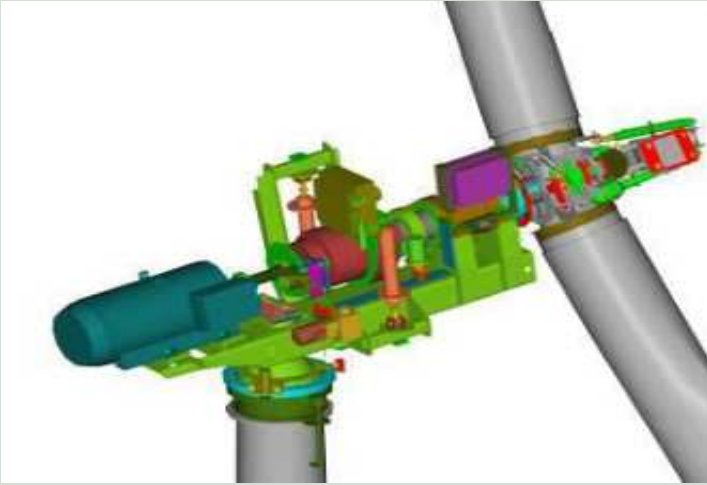
- First Wind Farm in Nigeria (Pilot Project)
- Government funded
- Wind farm consists of 37 turbines with 275 kW each
- Total capacity: 10 MW
- Arrangement of the turbines in two rows
- In the between the two rows 2 existing 132 kV OHL
- Complete area fenced
- Access Road to a village is passing the area

Wind Turbine Technology

- Focus from the Federal Ministry of Power:
 - Small Units
 - Simple Technology

Vergnet SA was chosen

- 2 blade rotor technology on a teetering hub
- Rated Power: 275 kW
- 2 speed asynchronous generator
- 32 meter rotor diameter
- Guyed tubular mast, hub height: 60 meter
- More than 350 turbines of this type installed world wide
- No huge crane needed for installation, no ladder inside (excavator is feasible)
- Turbine will be lifted down for maintenance



- Construction started in the end of 2010
- Main construction works complete in beginning of 2012
- Commissioning scheduled for end of 2012



- Status 2018:
 - 15 of 37 turbines running
 - Commissioning works for remaining WTG's are ongoing



Challenges



- Security Situation
 - A commissioning engineer was kidnapped in the end of 2012 and released one year later
 - The contractor declared force majeure and left the project
 - Ongoing problems with vandalism of goods and components of the wind farm (i.e. cutting and stealing of copper cables)
- Solution:
 - Training Nigerian Engineers and Technicians for executing these works on behalf of the contractor
- Insufficient Funding after the incident
- Difficult commercial situation by importing material (custom clearance)

Presentation

Ashegoda Wind Farm

Ethiopia

Ashegoda Wind Farm

Key Facts:

- Total capacity:
120 MW
- 30x Vergnet GEV
HP 1 MW
- 54x Alstom ECO 74
1.67 MW
- Year of
Commissioning:
 1. phase 2011
 2. phase 2013



Ashegoda Wind Farm



Ashegoda Wind Farm



Ashegoda Wind Farm



Ashegoda Wind Farm



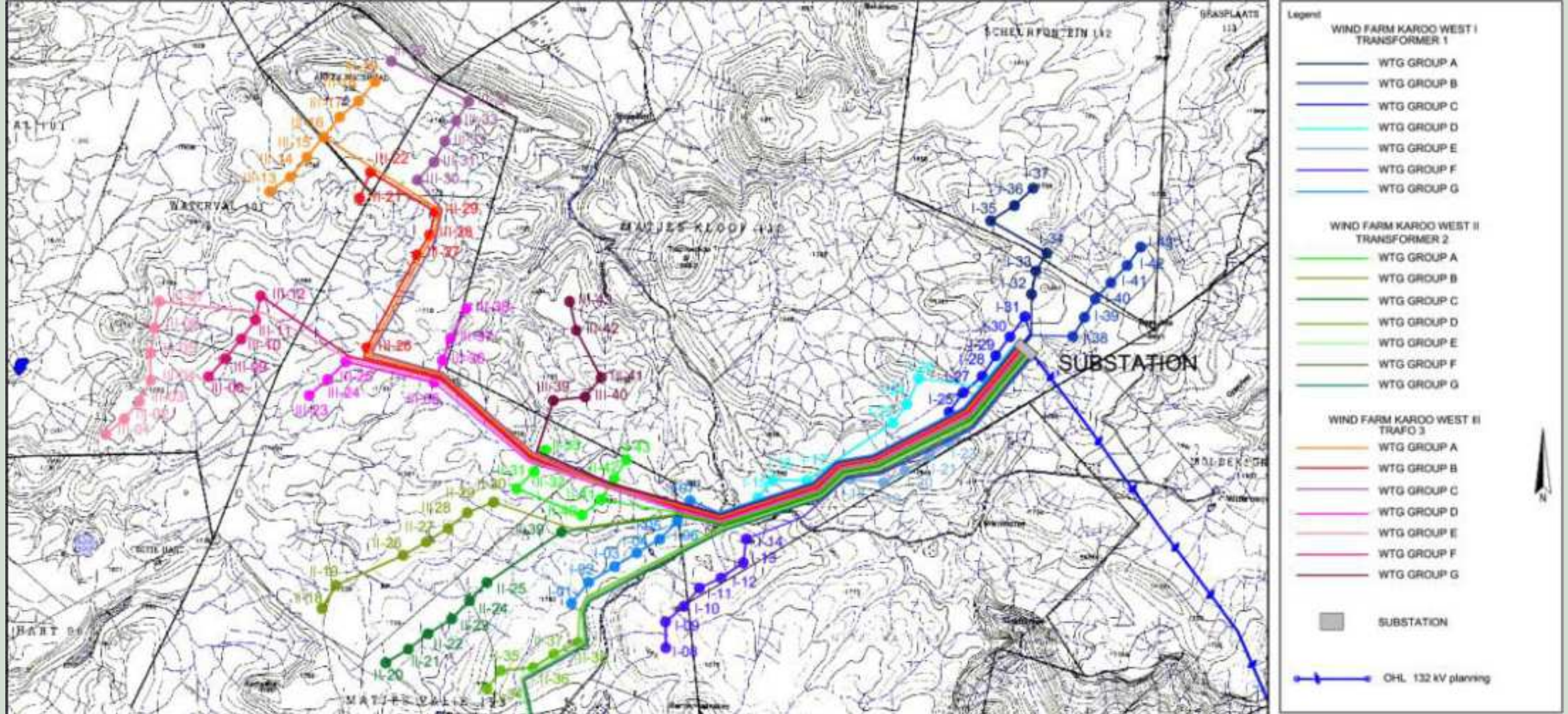
Ashegoda Wind Farm



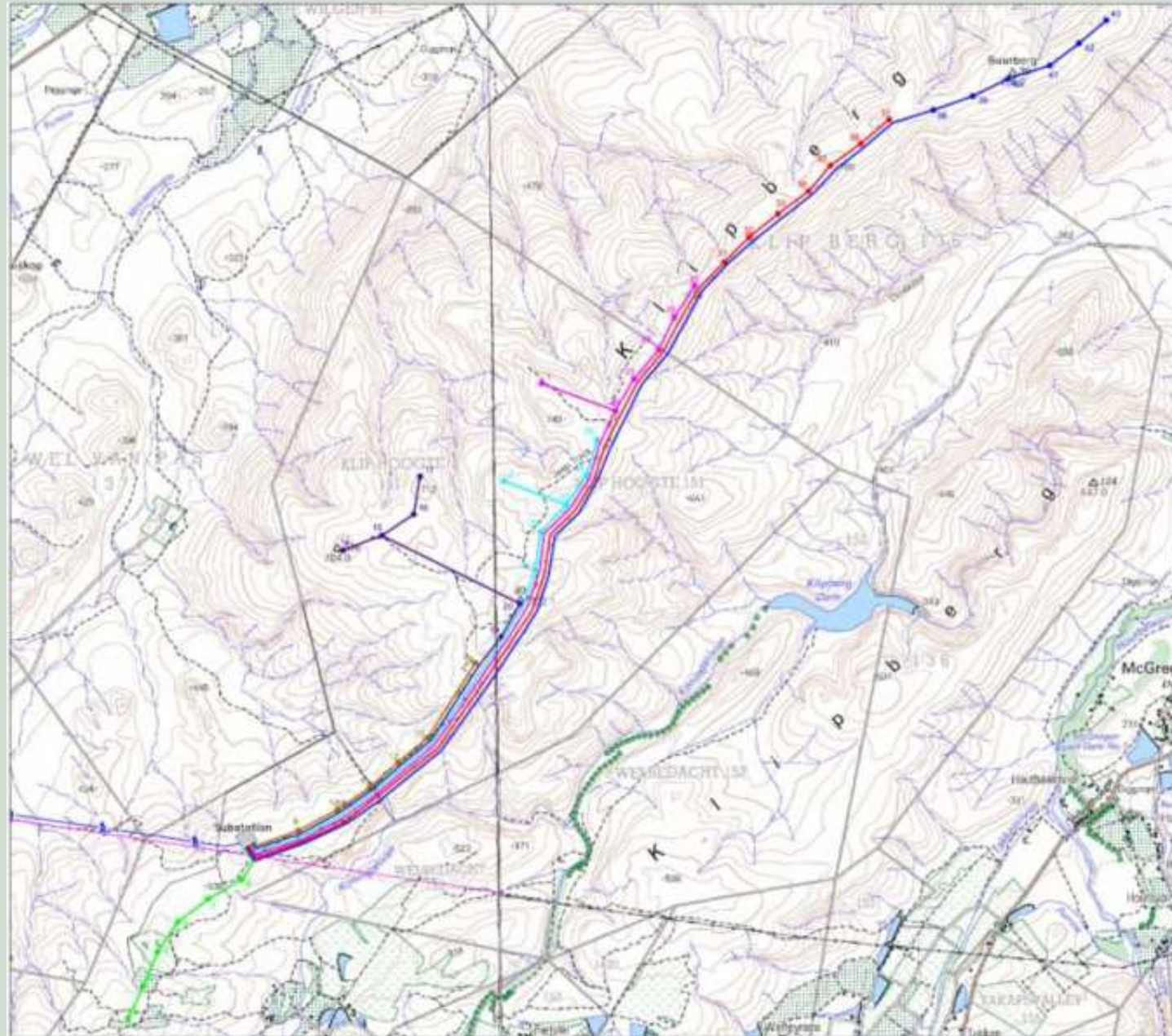
TERRAWATT

Impressions from Africa

Karoo West Wind Farm



Mc Gregor Wind Farm



Legend

- WTG GROUP A
- WTG GROUP B
- WTG GROUP C
- WTG GROUP D
- WTG GROUP E
- WTG GROUP F
- WTG GROUP G
- OhL 132 kV
- SUBSTATION



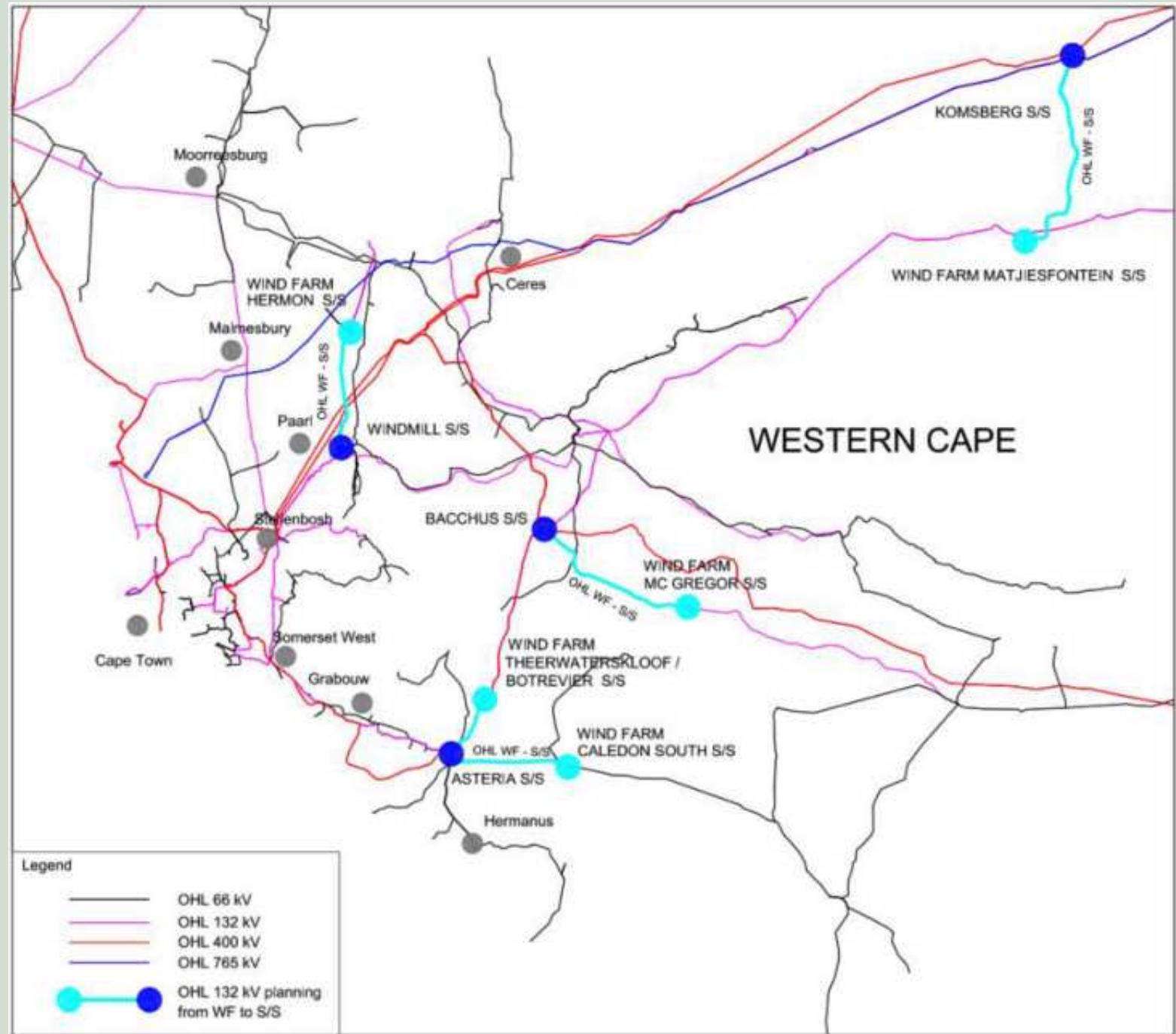
DRAFT



4 LAWRETT INTERNATIONAL		PROJECT NO. 10000000000000000000
WIND FARM McGregor		DATE: 10/10/2011
43 x SWT 3.2		SCALE: 1:5000
WIND FARM ELECTRICAL LAYOUT		DRAWN BY: [Name]
Overview		CHECKED BY: [Name]
DATE: 10/10/2011	SCALE: 1:5000	PROJECT NO: 10000000000000000000



Mc Gregor Wind Farm



Presentation Solar System Namibia

KLEINES HEIM SOLAR PV SYSTEM WITH BATTERY BACKUP



Solar Modules
58 x SI-Classic P260
SI Modules GmbH



Inverter
3 x Powador 5500
Kaco New Energy GmbH



Battery Inverter
1 x gridsave 000
Kaco New Energy GmbH



Battery Storage
24 x 2V 5 OPzS
solar power 350 Hapecker

+ backup supply
during grid outage

Consumers at
Kleines Heim



Grid
Connection

- ▶ Annual Grid Feed-in: 28,820 kWh
- ▶ Specific Annual Yield: 1,948.63 kWh/kWp
- ▶ CO2 emissions avoided: 16,992 kg/year



This project is part of the worldwide dena Renewable Energy Solutions Programme coordinated by Deutsche Energie-Agentur (dena) - the German Energy Agency - and co-financed by the German Federal Ministry for Economic Affairs and Energy (BMWi) within the German Energy Solutions Initiative.



Namibia Solar System

Key Facts:

- Roof mounted solar panels
- Capacity: 15 kWp
- Battery back up system
- Annual grid feed in: 28,820 kWh
- Specific Energy Yield: 1,948 kWh/kWp



Namibia Solar System



Namibia Solar System





Terrawatt Photovoltaic parks in Germany

Taucha, near Leipzig



Gornau, near Chemnitz



CONTACT

Poetenweg 49, 04155
Leipzig/Germany

Tel: +49 341 562970

Fax: +49 341 5629719

www.terrawatt.de

info@terrawatt.de



TERRAWATT

Thank you for your attention!



TERRAWATT