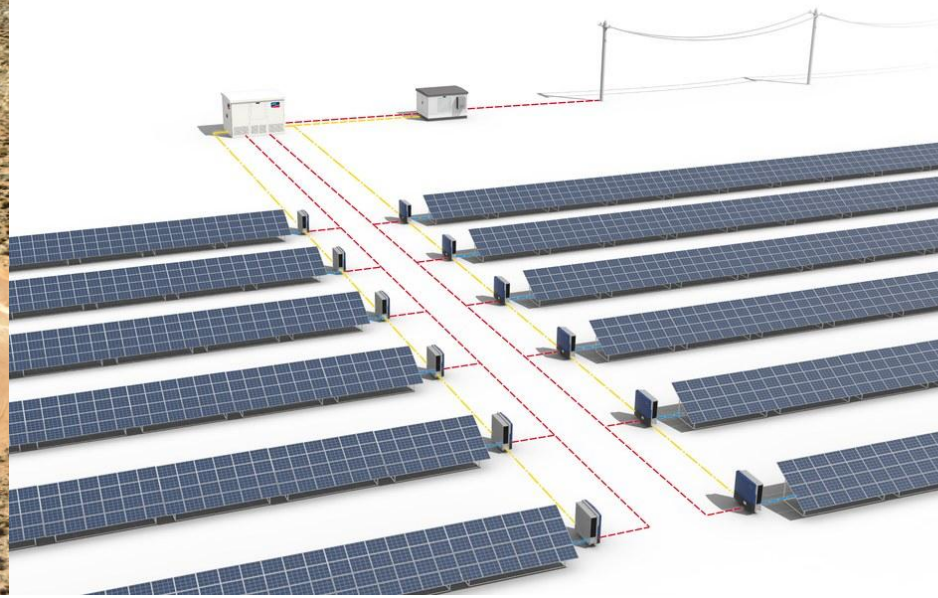


Layout and sizing of 1MWp stand alone power plants in Nigeria

Presented by Jürgen Raach
At Energieworkshop Wipro GmbH in Dresden
Date: 01.12.2014

Table of contents

1. Company profile

AFRICA

- ABIDJAN, Ivory Coast
- ACCRA, Ghana
- ADDIS ABABA, Ethiopia
- ALGIER, Algeria
- ANTANANARIVO, Madagascar
- ASMARA, Eritrea
- BUJUMBURA, Burundi
- DAKAR, Senegal
- JEDDAH, Saudi Arabia
- RIADH, Saudi Arabia
- JOHANNESBURG, South Africa
- KAMPALA, Uganda
- KINSHASA, Dem. Rep. Of Congo
- LAGOS, Nigeria
- LOMÉ, Togo
- LUSAKA, Zambia

AFRICA

- LUSAKA, Zambia
- N´DJAMENA, Chad
- NOUAKCHOTT, Mauritania
- OUAGADOUGOU, Burkina Faso
- TUNIS, Tunisia
- YAOUNDÉ, Cameroon

EUROPE

- ULM, Germany
- BOURDEAUX, France

ASIA

- NEW DELHI, India
- KONYA, Turkey

1. Company profile

SOLAR 23

SINES GROUP

SINES FRANCE

SOLAR 23

S.IN.E.S Industrie

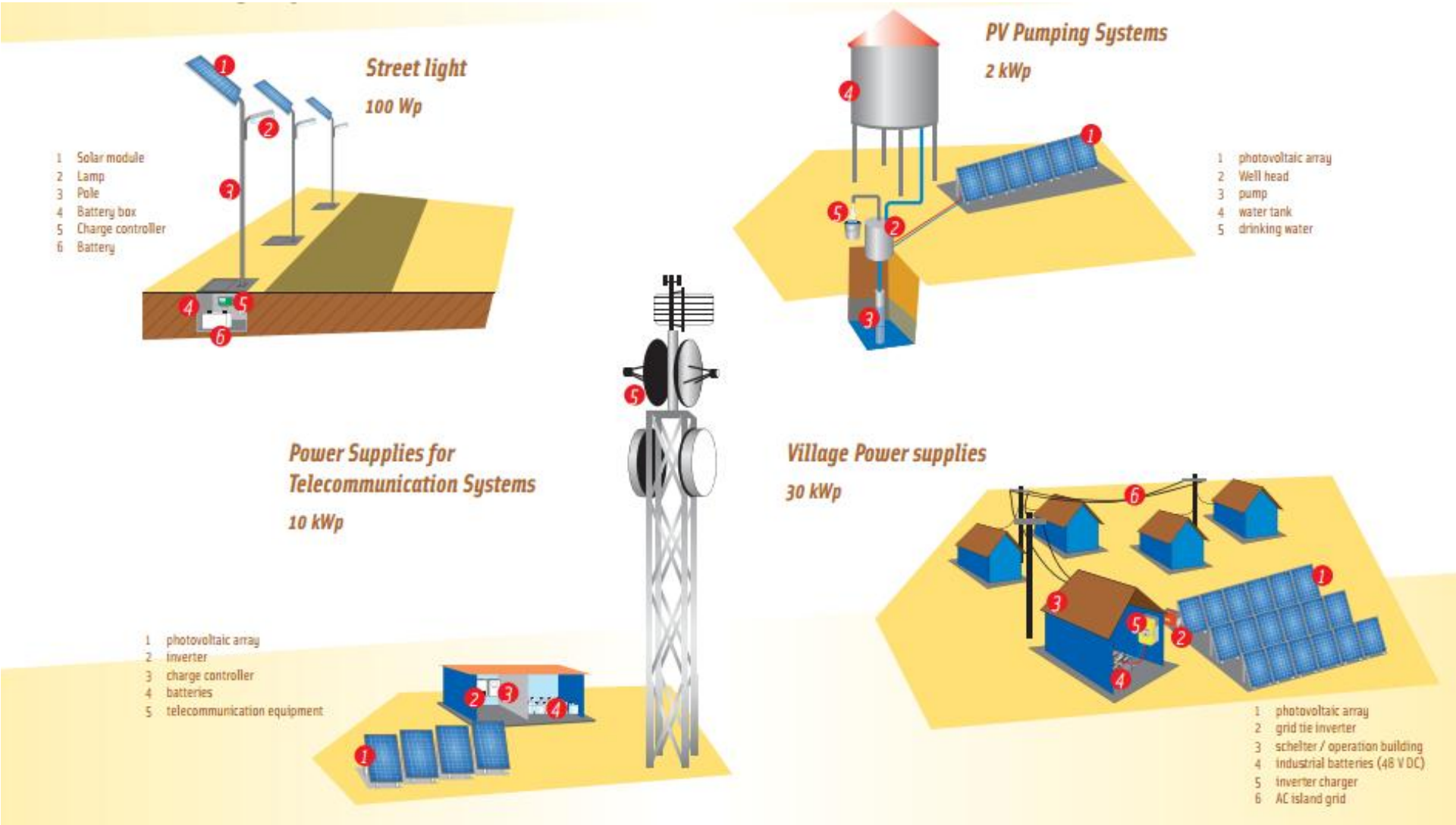
S.IN.E.S

SINES IT SOLUTIONS

FILTRASUN

1. Company profile

EPC = Engineering, Procurement & Commissioning



1. Company profile

UNICEF Copenhagen
pumping projects, Delivery materials

GIZ
ON-GRID / OFF-GRID System, Consulting support

FRES Netherland
Solar Home Systems, Delivery materials

GRET
Multi-functional energy-providing Platforms, Delivery materials and Installation

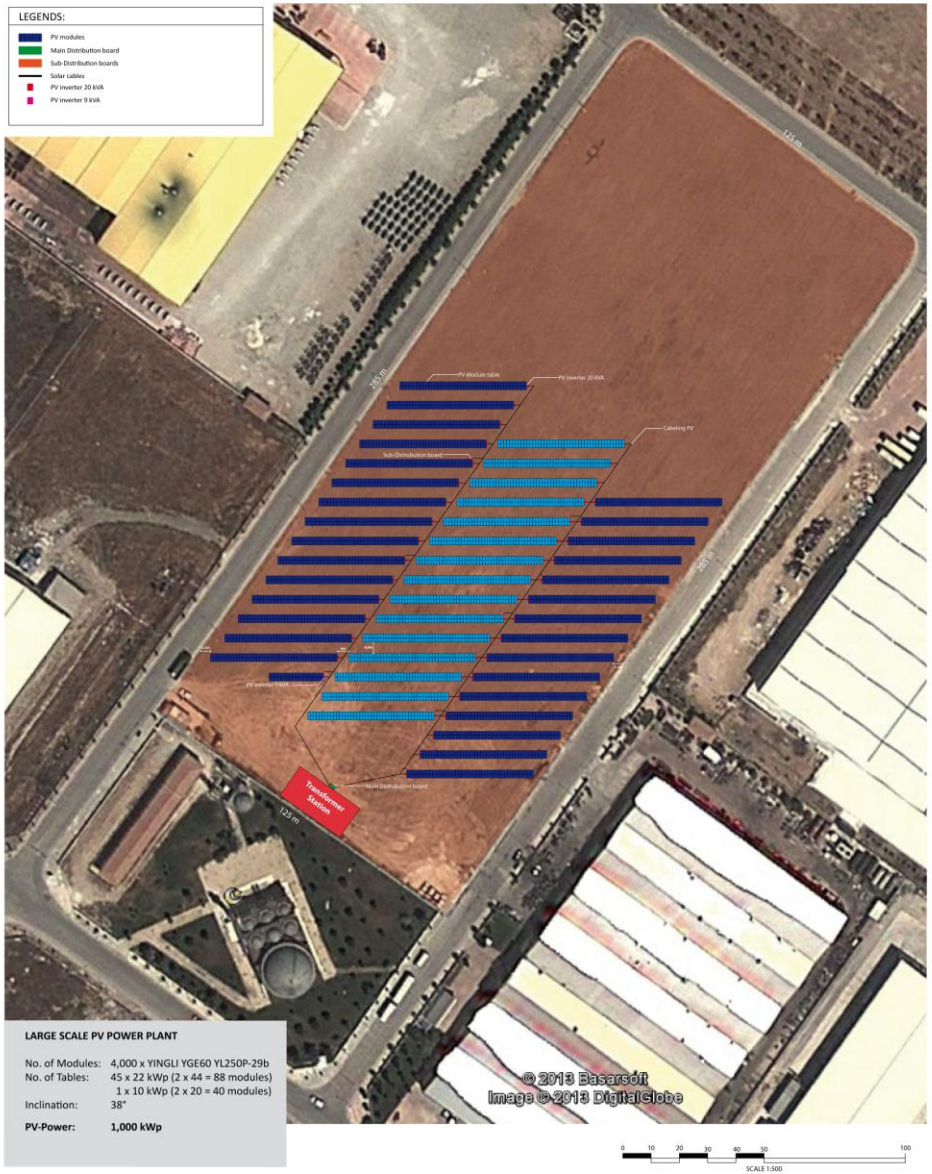
WHO
Health supporting PV-Projects as f.ex. systems for vaccination cooling

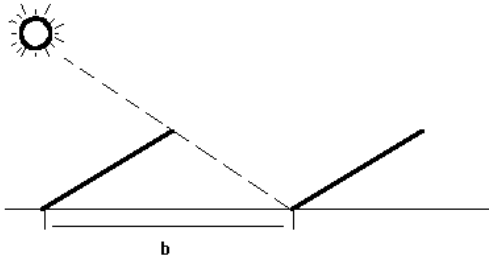
FAO
PV Refrigerator Systems, Delivery materials

1. Company profile

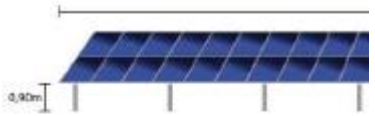
- Solar modules
- Electronic components
- Solar pumps
- Batteries

2. Solar module coverage plan

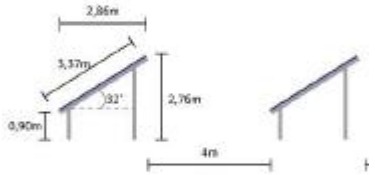




Front view

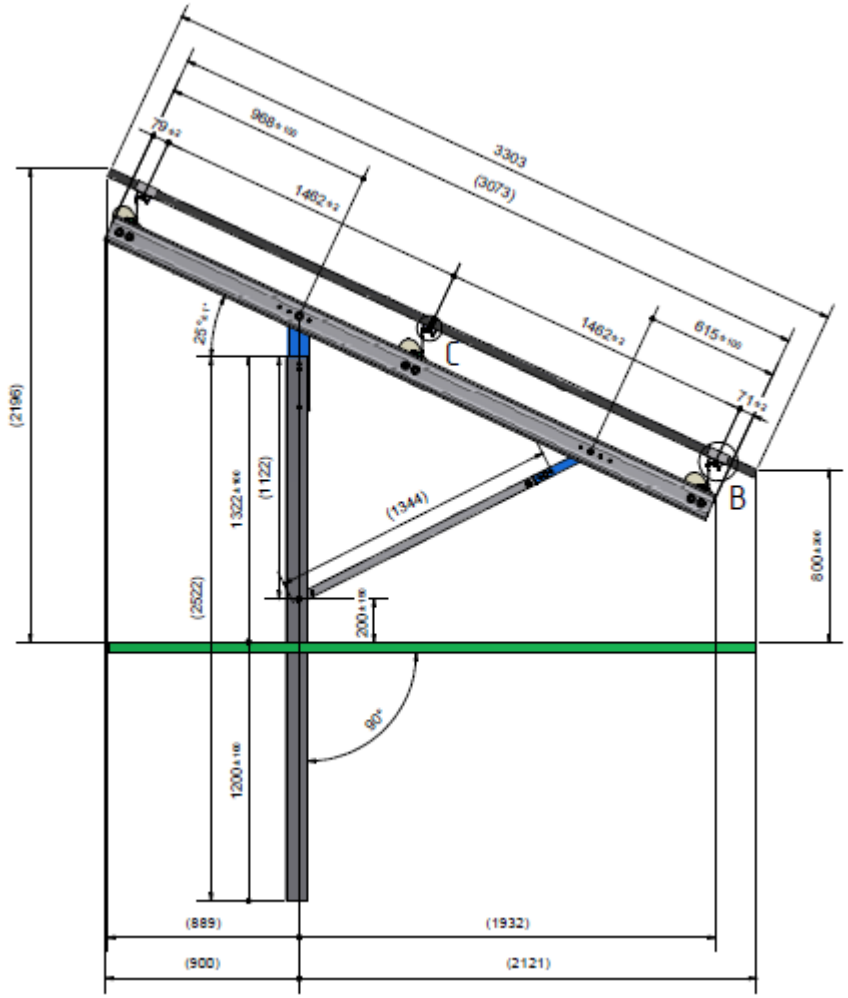


Side view



Bird´s eye view

2. Solar module coverage plan



3. Software simulation

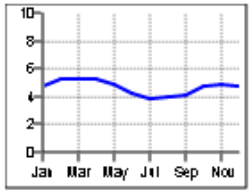
City	LAGOS-IKEJA	Latitude	6,3	Search Parameters	
Region/ST		Longitude	3,2		City
Country	NIGERIA	Elevation	38	City	Lagos
Comments	South African Weather Bureau, South				

	GH Insolation kWh/m2/day	Avg Temp Deg C	Temp Swing + / - Deg C	Reflectance (0.20 = 20%)
Jan	4,7	26,6	5,0	0,20
Feb	5,3	27,5	5,0	0,20
Mar	5,3	27,6	5,0	0,20
Apr	5,3	27,3	5,0	0,20
May	4,9	26,6	5,0	0,20
Jun	4,2	25,5	5,0	0,20
Jul	3,9	24,3	5,0	0,20
Aug	4	24,2	5,0	0,20
Sep	4,1	25	5,0	0,20
Oct	4,7	25,5	5,0	0,20
Nov	4,9	26,7	5,0	0,20
Dec	4,8	26,7	5,0	0,20

LAGOS-IKEJA

NIGERIA

6,3 / 3,2

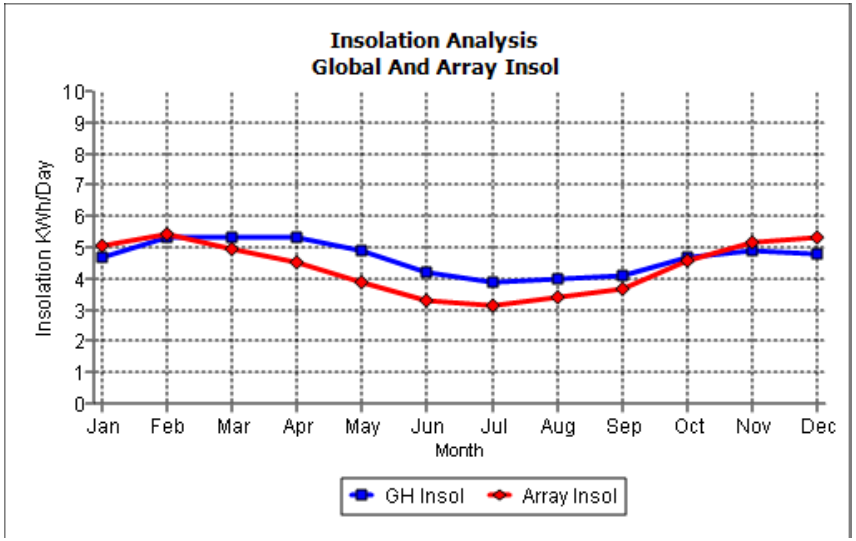


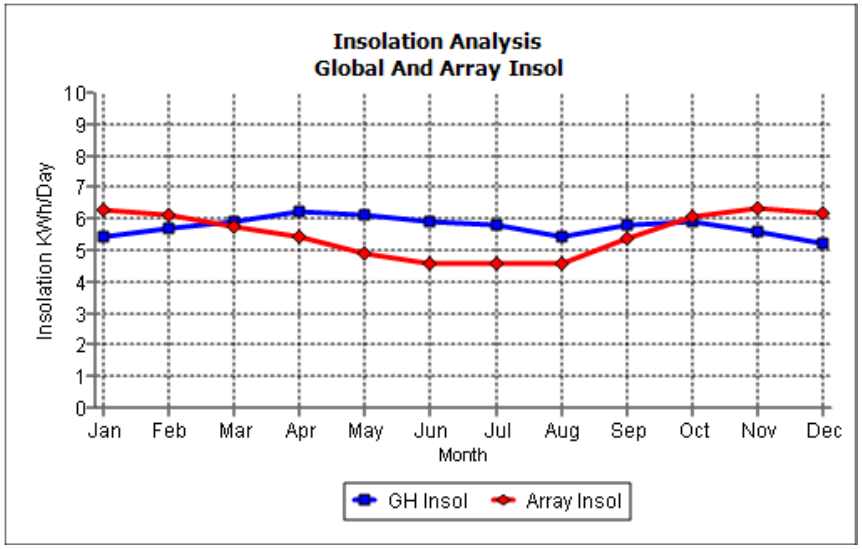
Accept Edit DB

Mont	Horiz Insol kWh/m2/d	Avg Temp DegC	Clearness KT_bar	Tilt Factor	Array Insol kWh/m2/d
Jan	4,70	26,6	0,51	1,05	4,95
Feb	5,30	27,5	0,54	0,97	5,15
Mar	5,30	27,6	0,52	0,85	4,49
Apr	5,30	27,3	0,51	0,73	3,89
May	4,90	26,6	0,49	0,66	3,22
Jun	4,20	25,5	0,43	0,65	2,72
Jul	3,90	24,3	0,39	0,68	2,64
Aug	4,00	24,2	0,39	0,73	2,91
Sep	4,10	25,0	0,40	0,81	3,30
Oct	4,70	25,5	0,47	0,91	4,26
Nov	4,90	26,7	0,52	1,02	4,99
Dec	4,80	26,7	0,53	1,09	5,21

3. Software simulation

Irradiation data LAGOS versus KANO

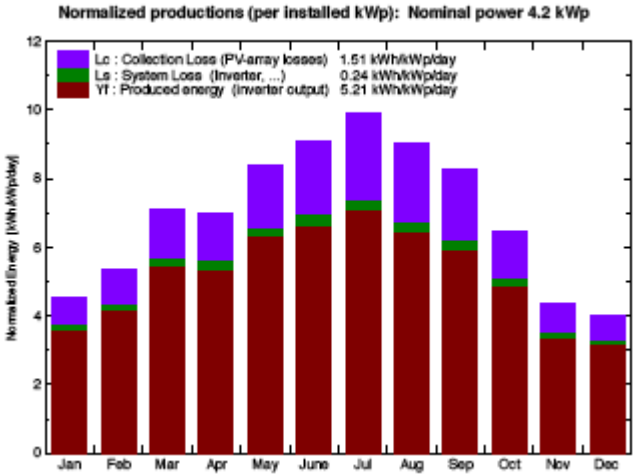




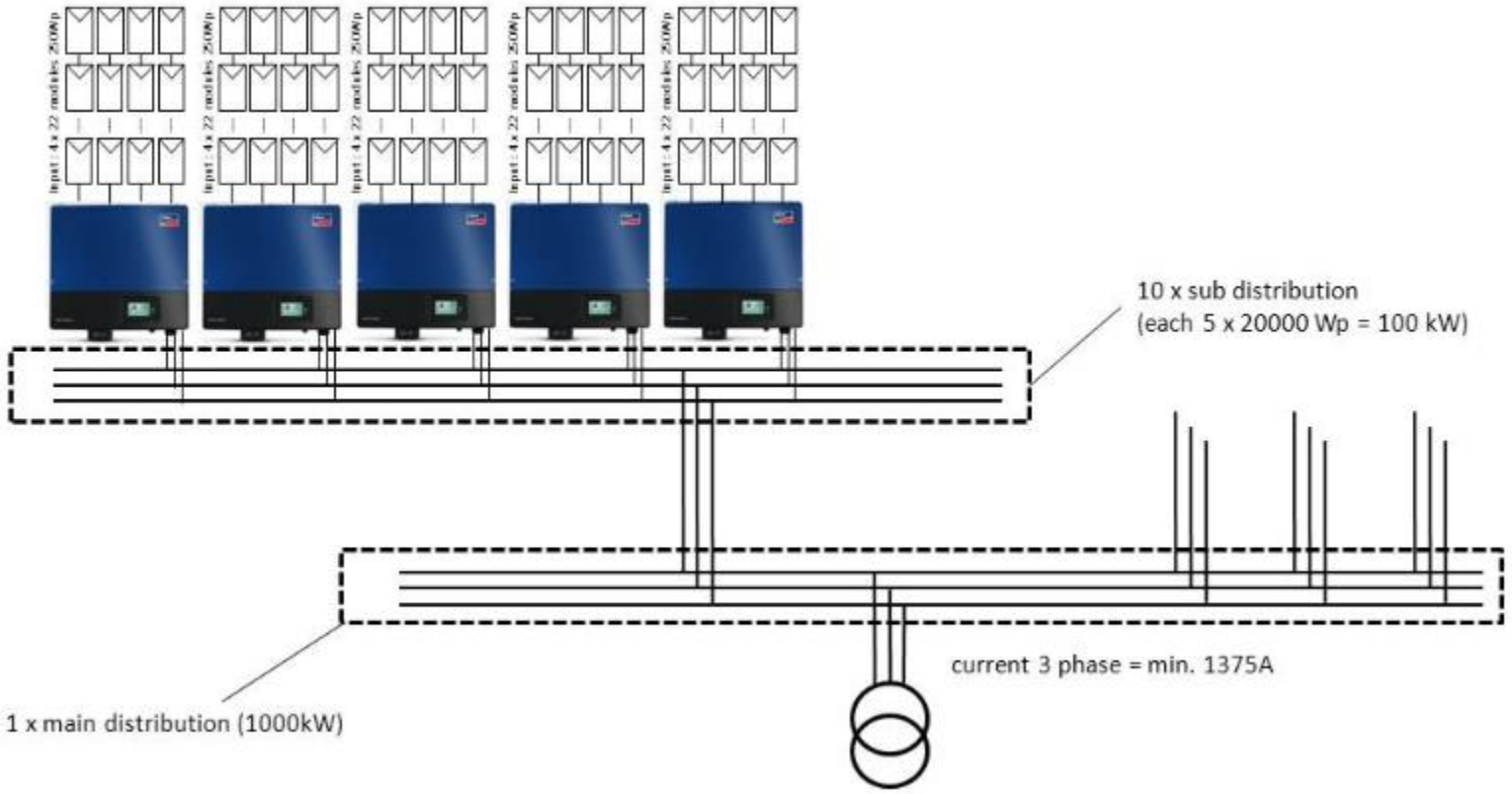
3. Software simulation

Simulation of annual energy yield

Technical data			
Total number of PV modules:	864	Annual energy yield (approx.)*:	296,29 MWh
Peak power:	216,00 kWp	Energy usability factor:	100 %
Number of inverters:	13	Performance ratio (approx.)*:	83,9 %
Nominal AC power:	216,00 kW	Spec. energy yield (approx.)*:	1372 kWh/kWp
AC active power:	216,00 kW	Line losses (in % of PV energy):	---
Active power ratio:	100 %	Unbalanced load:	0,00 VA



4. AC Sub- and main distribution



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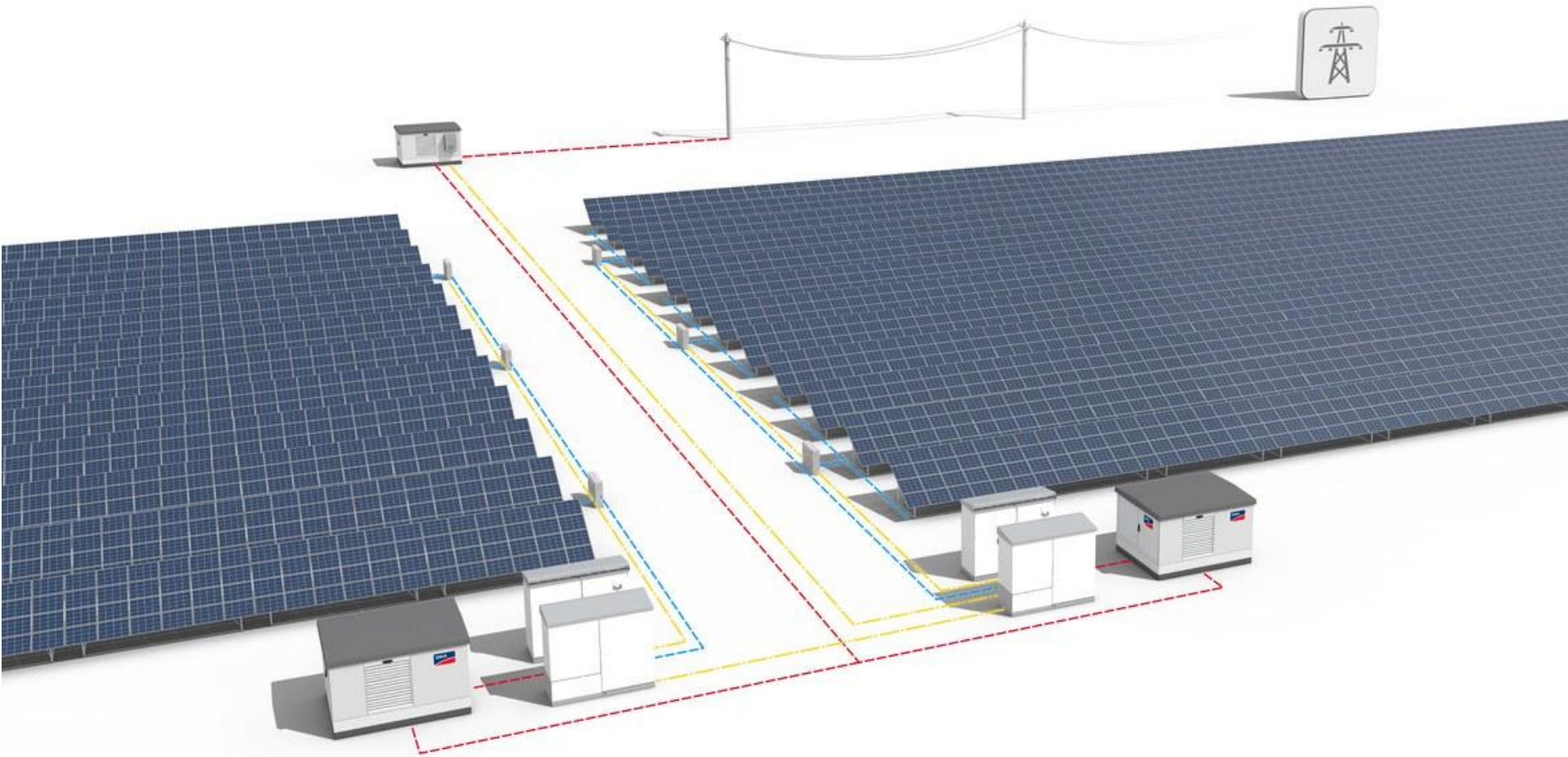
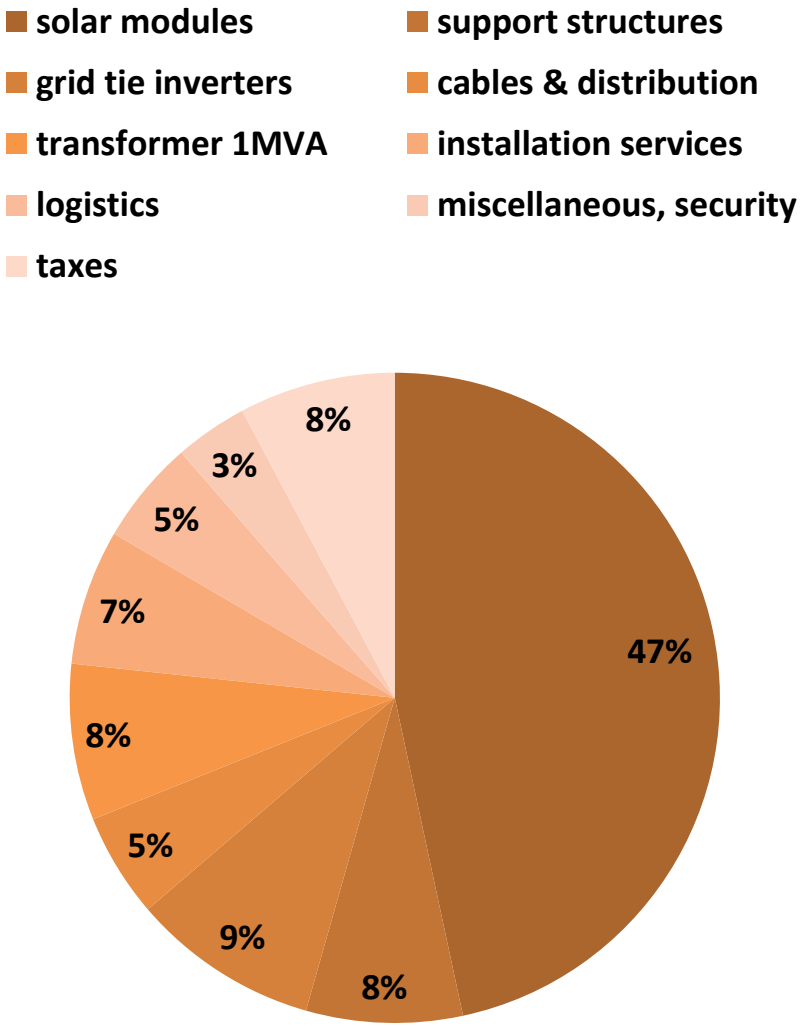


Source: SMA

5. Bill of materials & cost break down

Product
Modules & Installation (PV Panel v
GERMAN SOLAR GSP-P60-250
SOLARWORLD SW250 poly
YINGLI Solar
Installation
Modul installation costs (Turkish installation team)
Inverter & Installation (Invertör ve
SMA STP20000TLEE-10
SMA Speedwire/Webconnect for STP20000TLEE-10
Extension of warranty
SMA STP9000TL-20
SMA Speedwire/Webconnect for STP9000TL-20
Extension of warranty
POWFFER MEGAGalaxy 20KTL (FOB Shanghai, incl. 10 y
Installation
DC installation costs (Turkish installation team)
Support Structure & Installation (Kc
Support structure
SCHLETTER FS-Una for PV power plants
Installation
SCHLETTER Installation of support structure incl. site e
SCHLETTER geological expertise
Wiring & Installation (Kablolama ve
Wiring
HELUKABEL HK-SO-SOLARFLEX_®PV1-F 1x6mm²/ 704
HELUKABEL NYY J5x16mm² RE / 32064
HELUKABEL NAYY-J5x95mm² / 33281
HELUKABEL NAYY-J5x50mm² / 32257
HELUKABEL NAYY-J5x35mm² / 32300
HELUKABEL NYY-J 4x240mm²SM / 32058
4x95/16mm² XLPE (4p.sr.)
Installation
AC installation costs (Turkish installation team)



6. Taxes & import duties

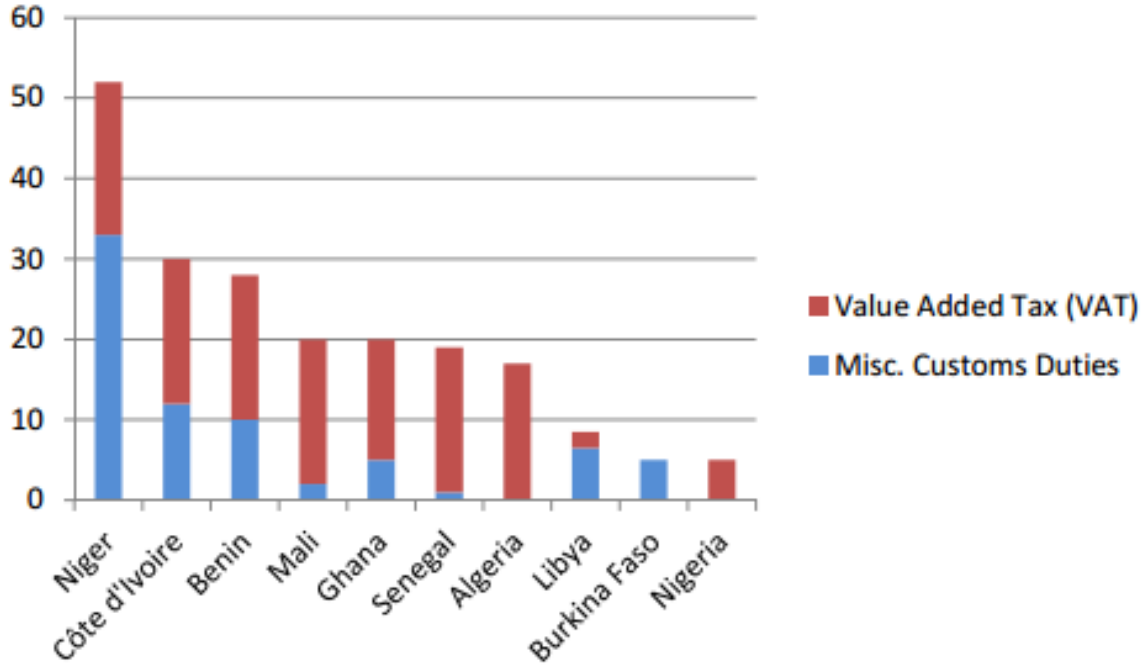


Figure 8: comparison of West-African VAT
and customs duties in selected countries in fiscal year 2013
Source: RAACH SOLAR

8. Electricity production cost

$$Kd = (Ao) \times [i(1+i)n] / [(1+i)n-1]$$

Kd = capital service

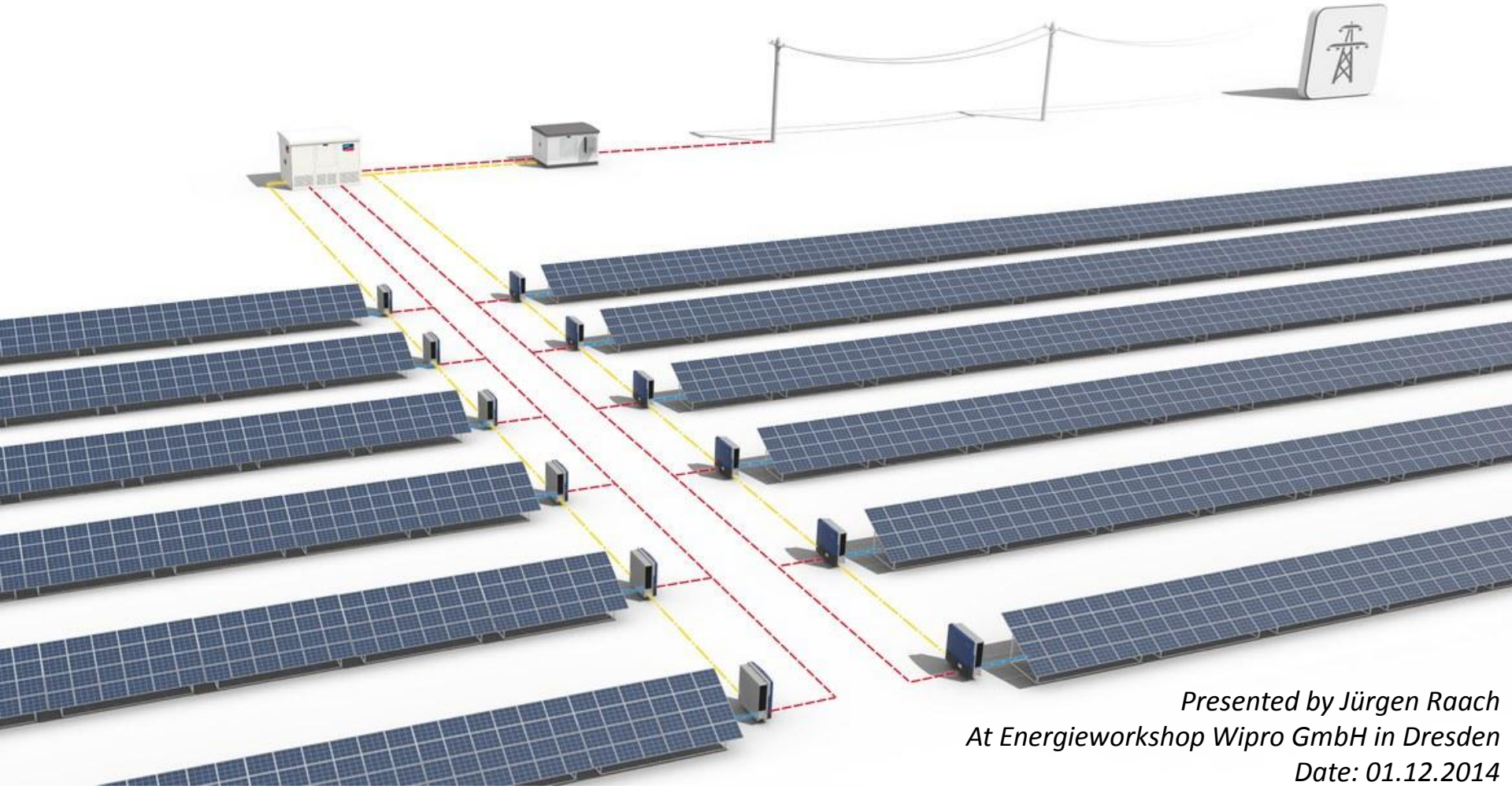
Ao = initial investment cost

I = P/100 interest rate

n = utilisation period

electricty production cost = 0,30€ / kWh
(without grid)

THANK YOU FOR YOUR ATTENTION



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