



Mini-grid Implementation
Experience as an EPC Contractor

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Juwi international GmbH

PART I – Company Profile



juwi AG
Segments &
Markets

juwi at a glance



Company structure

- Founded in 1996 by Fred Jung and Matthias Willenbacher (juwi),
- juwi Holding AG is an owner-managed group of companies and not listed on the stock exchange

Employees

> 1,650 employees (worldwide)

Revenues

around 1.0 billion € in 2012

Total capacity

around 2,000 megawatt (2,000 plants)

Worldwide activities

- subsidiaries and offices in 13 countries
- F.i. in Central Europe, USA, Chile, Costa Rica, Singapore, India, South Africa



juwi headquarters in Wörrstadt

juwi's market segments



On-grid Power Plants

Wind Energy

- more than 540 wind turbines = > 950 MW of installed

Solar Energy

- more than 1.500 PV installations = > 1.000 MWp installed

Bio Energy

- 5 biogas power plants, 4 wood pellet production facilities etc.

Hybrid Systems

- Since 2009
- More then 50 Projects in Africa, Latin America, South Asia



Plouguin wind farm, Bretagne

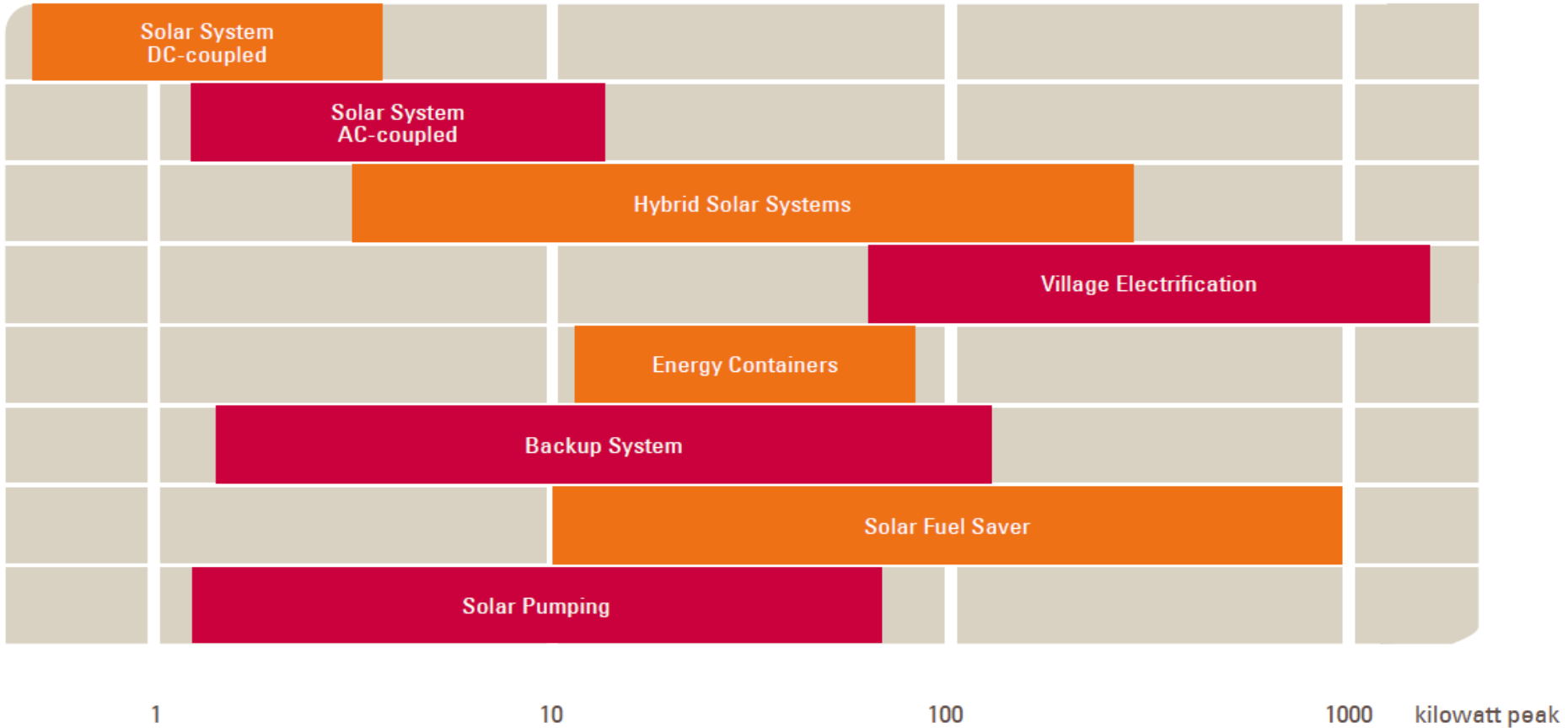


PV-free-field installation Drama, Greece



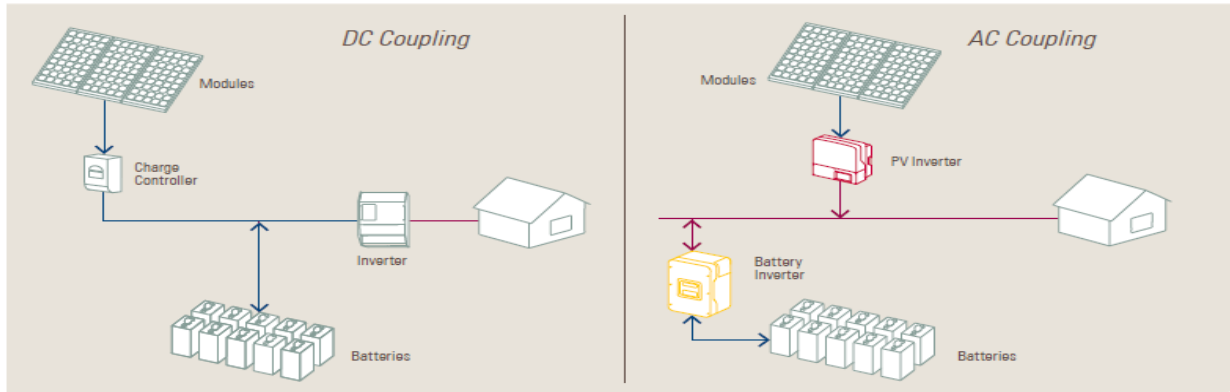
Hybrid system Tsumkwe, Namibia

Hybrid Systems Solutions



Off-grid Systems

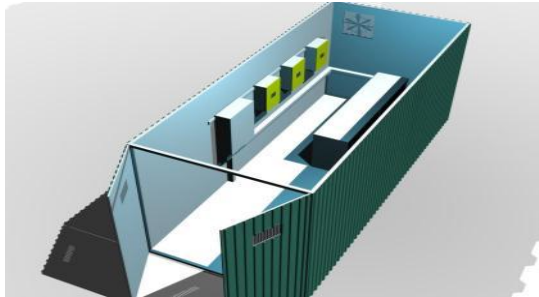
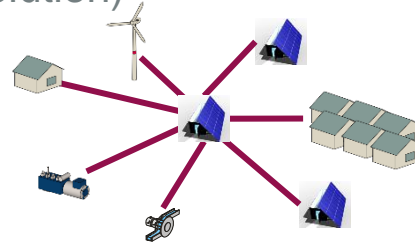
- DC or AC couples off-grid systems
- Power range 1kW – 300 kW
- Flexible adaption to clients needs
- Typical applications: telecom, hotels, healt centers, ...



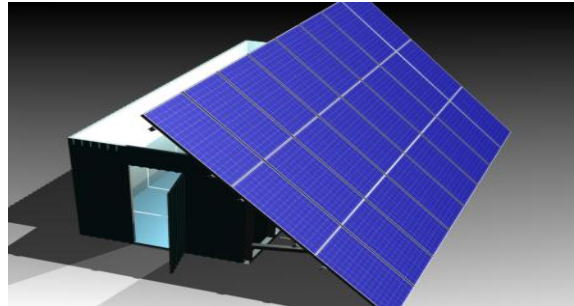
Containerized Systems

Containerized solutions with external or internal solar field

- Free field installation with concrete foundations
- Power from 2 kWp to 300kWp (standard solution)
- Power > 300 kWp (project solution)
- Modular concept



30kWp system in 20" container (external solar field)

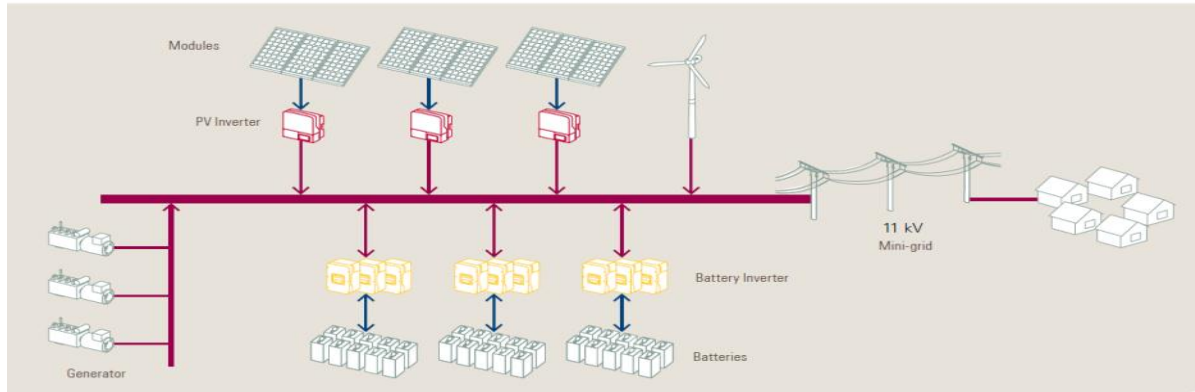


5 kWp system in 20" container



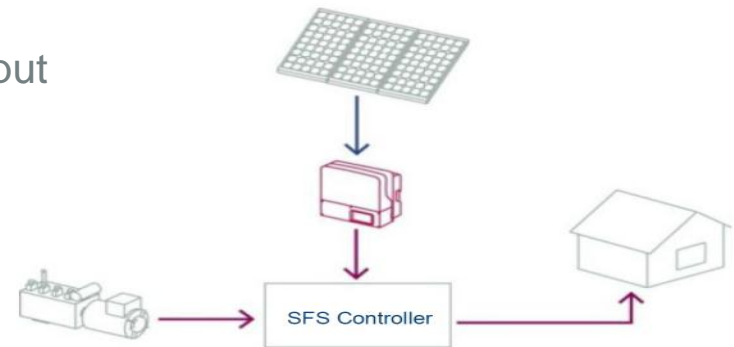
Village Electrification

- Electrification of communities and villages with electricity
- Integration of Mini-Grids and intelligent metering systems
- Control mechanisms for generation and load management
- Typical applications: villages, communities, school complex, ...



Solar Fuel Saver

- Solar power is directly injected in the diesel generator mini grid
- Reduction of fuel consumption due to solar energy penetration
- No batteries are needed
- Decrease in generation costs due to fuel saving
- The SFS controller manages the solar power output according to the operation of the Diesel generator



PART II – The off-grid Market

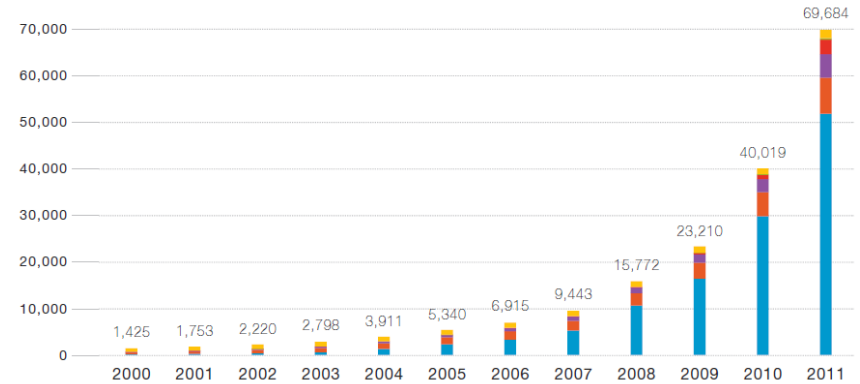


Market Approach
&
Opportunities

Solar market 2012 – on and off-grid

Installed PV power

- World wide: 101 GWp* (EPIA 12.02.2013)
- New installed : 30 GWp in 2012
- Germany: 7,6 GWp in 2012



Installed off-grid PV power

- MEA-PV-total: 131 MWp in 2011 (EPIA 2012)
- How high is the off-grid part?

→ Africa off-grid 2011 = 70 - 100 MWp! **≡**



71 MWp juwi solar plant in Lieberose



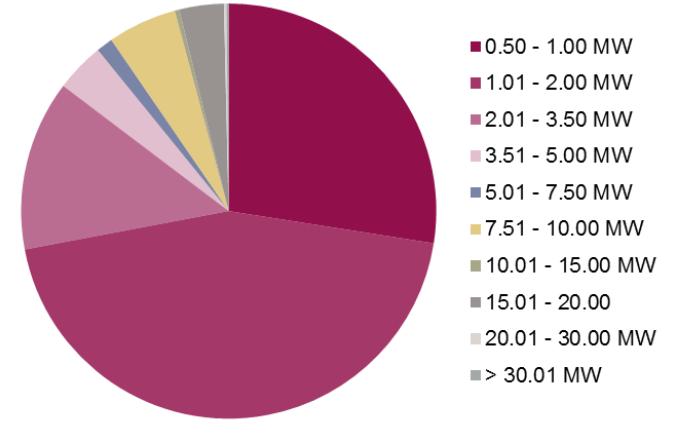
Remark: Total capacity of african utilities is approx 103 GW!

Africa: Prospects are good

1. PV-Diesel Applications

- Diesel price development vs. Module price development
- LCOE costs by Solar < LCOE costs by DG
- Governmental subsidy decrease for electricity
- Generator market 47GW/year (with approx. 3 GW per year in African applications with continuous power (Mini-Grids,...))

Diesel Generator sold in 2011 (47 GW)
[Power Generation Order Survey 2012]

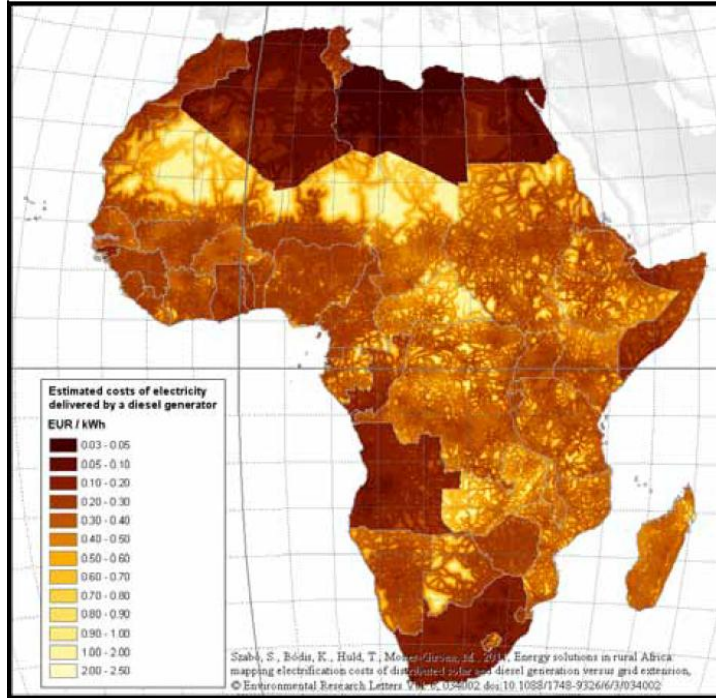


→ 80% of the market < 5MW (= 37 GW / year)

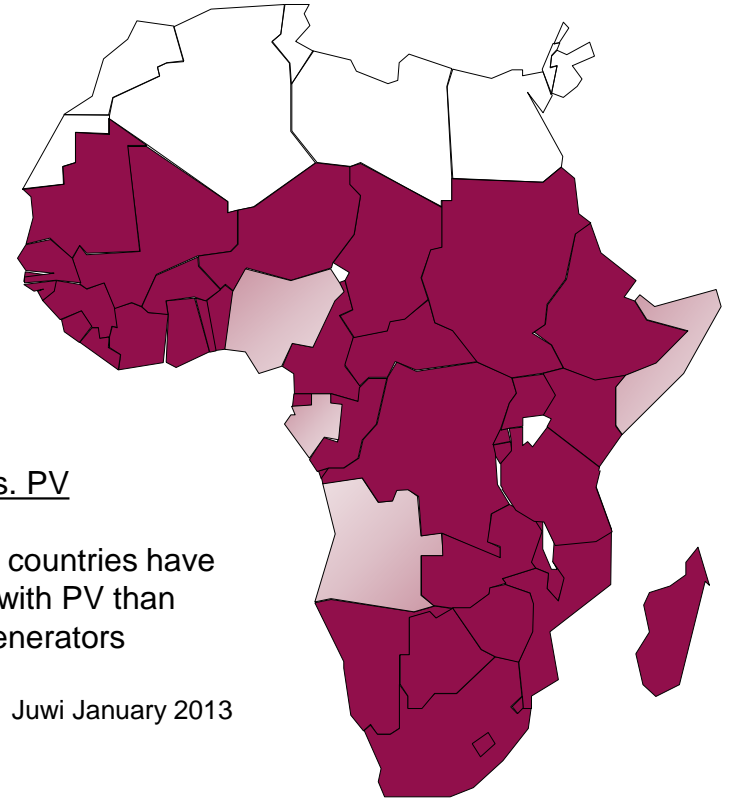
→ DG market in Africa : 10 GW/year

→ DG market for continuous power : 3 GW/year

Prospects: PV-Diesel (Solar Fuel Saver)



Generation costs (€/kWh) with diesel generator



Africa: Prospects are good

2. PV-Hybrid and Mini-Grids

High rate on non electrification

- Sub Sahara Africa: 25,9%,
- City population: 53%
- Rural population: 8%

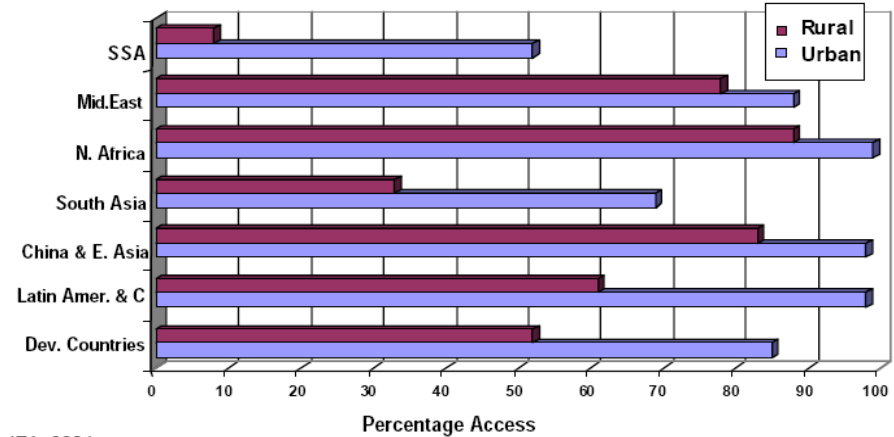
Existing Intelligent applications

- Intelligent meters & vending solutions
- Innovative energy management systems

Operation model

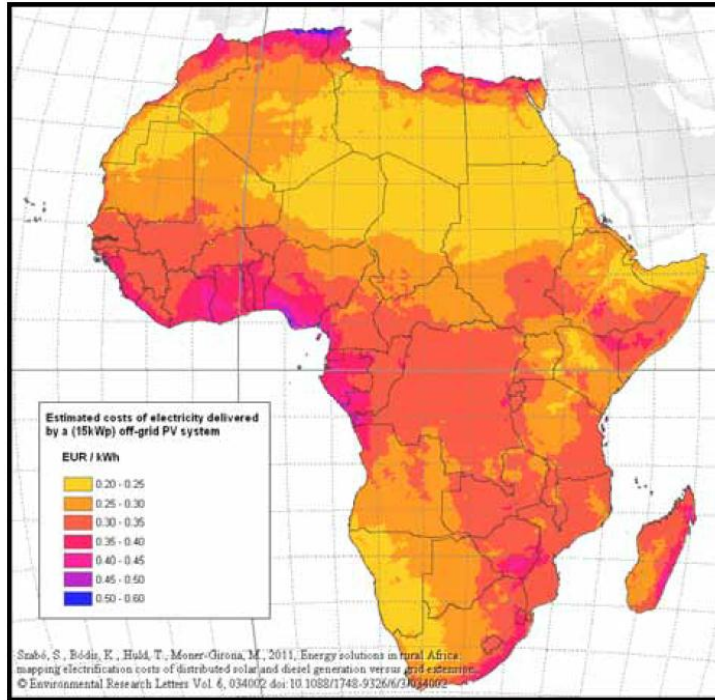
- Advantages in O&M for centralised Mini-Grids
- Standard electricity (AC, 230 V, 50Hz,...)

→ Especially for rural communities with load peaks during evening hours



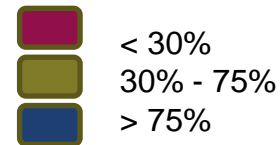
Source: IEA, 2004

Prospects Mini-Grids & PV-Hybrid

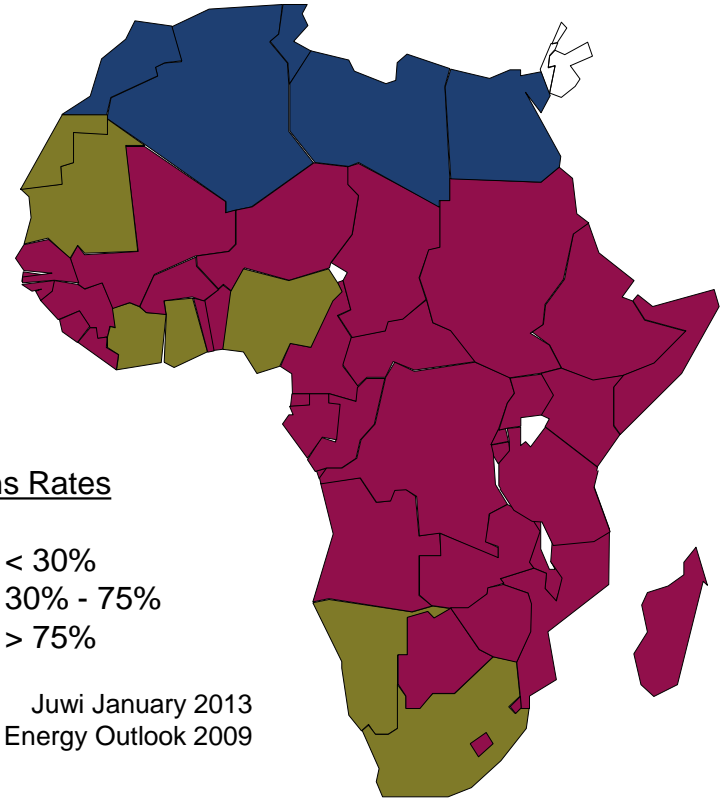


Generation costs (€/kWh) with 15kWp PV System

Electrifications Rates



Juwi January 2013
IEA Energy Outlook 2009



What to do to let this potential become a bigger market?



- **Innovative financing mechanisms** for hybrid systems to shift CAPEX to OPEX
- **Intelligent business models** for hybrid systems (focusing on O&M)
- **Political framework** that guarantees investors and EPCs local securities
- **Liberalization of the electricity market**
- **Abolition of import duties** on goods which can not produced locally
- **Knowledge transfer**
- **Unbureaucratic and transparent processes** for tendering and public negotiations

PART III – Examples



Mini-Grids in Africa



Low voltage Mini-Grid (Egypt)



Power Supply

- 50 kWp PV-Modules
- 50 kW wind turbines
- 60 kVA diesel Generator
- 500 kWh OPzS Battery Bank

Mini—Grid

- 400V
- Irrigation, houses, mosque, streetlight

Vending System

- invoice

Low voltage Mini-Grid, Desalination



Power Supply

- 20 kWp PV-Modules
- 50 kWh OPzV Battery Bank

Mini—Grid

- 400V
- Desalination, households, public lighting

Vending System

- invoice



Medium Voltage Mini-Grid (Namibia)



Power Supply

- 201 kWp Poly crystalline PV-Module.
- 1 MWh OPzS Battery Bank
- DG: 2 x 140 kVA, 1 x 350 kVA

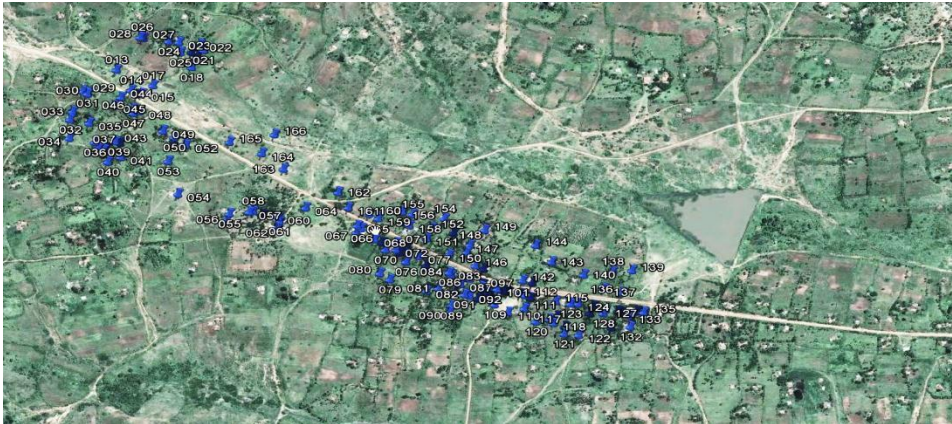
Mini—Grid

- 11kV (1 x step-up, 5 x step down)
- Two priority mini-grid
- 200 households, 1000 villagers

Vending System

- residential: pre-paid
- Commercial/public: invoice with 3 months cut

Low voltage Mini-Grid (Tanzania)



Power Supply

- 11 kWp PV-Modules (soon 33kWp)
- 100 kWh OPzV Battery Bank
- No diesel generator

Mini—Grid

- 400V
- 250 house holds, 150 yet connected

Vending System

- pre-paid

Thank You!



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