KRAFTWERK
RENEWABLE POWER SOLUTIONS

Introducing PV-diesel hybrid solutions in offgrid agriculture and tourism in Egypt

A development partnership with GIZ/BMZ

Dr. Roman Brinzanik

Cairo, May 22, 2017

POWER & SAVE
Cairo Solar

ComAp
The heart of smart control

Agenda

KRAFTWERK Renewable Power Solutions

PV-diesel hybrid solutions

Development partnership with GIZ/BMZ

KRAFTWERK – intelligent use of renewable energy

Solutions

Solar parks
as an investment

Self-consumption
for more independence

PV-Diesel Hybrid
for diesel savings

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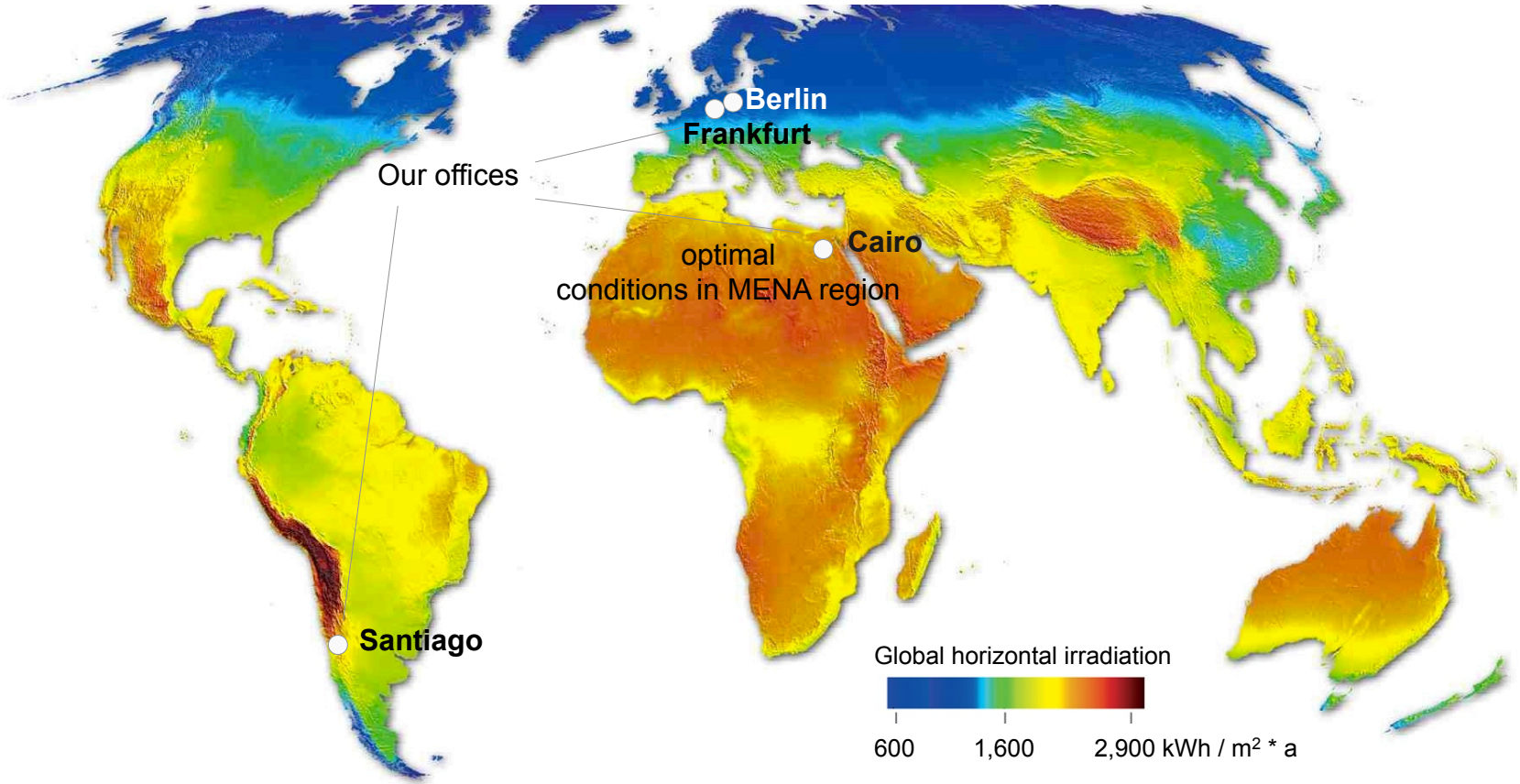
Development → **Implementation**

Feasibility studies
Yield analysis
Design und engineering
Permit procedures
Commissioning
Construction

Services

Our focus: high potential regions

Global irradiation map



PV is already market competitive in countries with high irradiation

Source: 3Tier Inc., 2010

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Cooperation with ComAp and Cairo Solar to bundle PV and genset/hybrid controller expertise

~650kWp PV installed in Egypt

Finance solutions

Office in Cairo

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many genset installations in Egypt

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European/ Egyptian engineers

Making PV-diesel hybrid plants happen in Egypt

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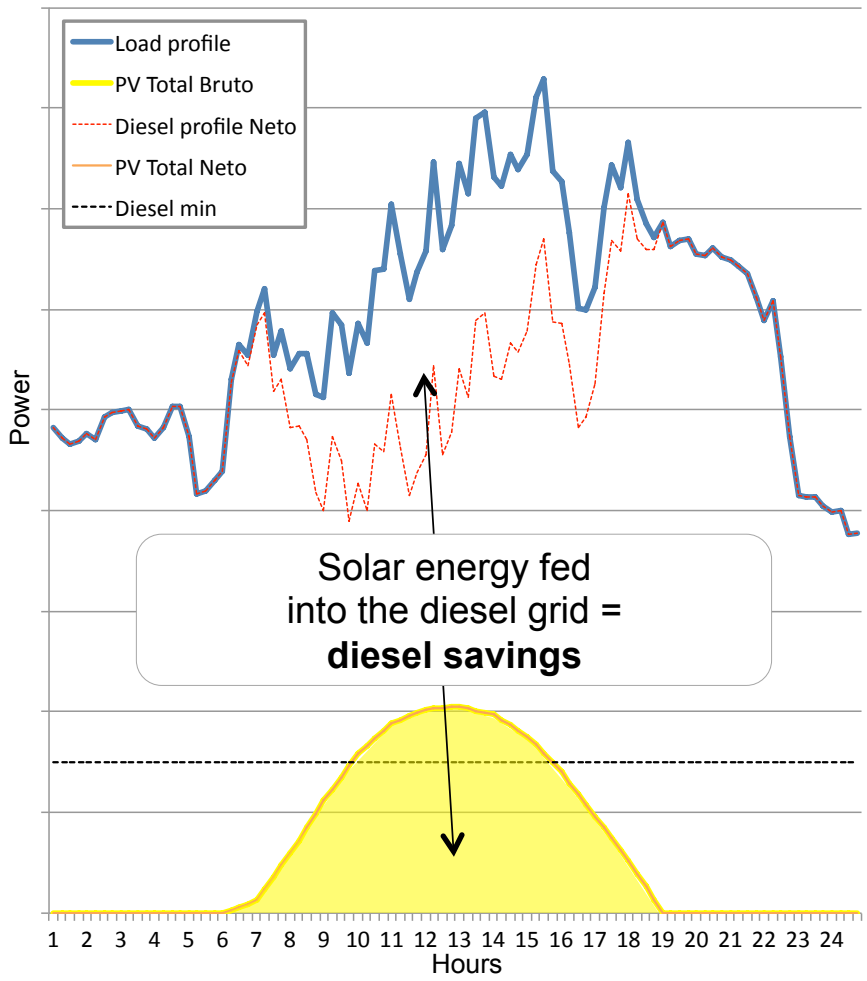
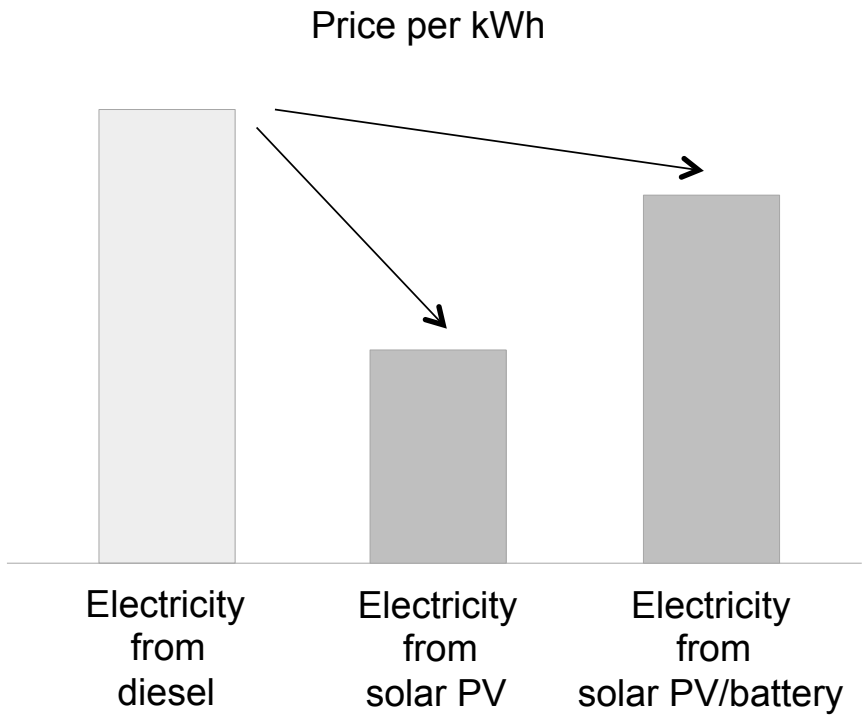
The principle: Substitution of diesel by solar electricity

24 hour load and solar profile



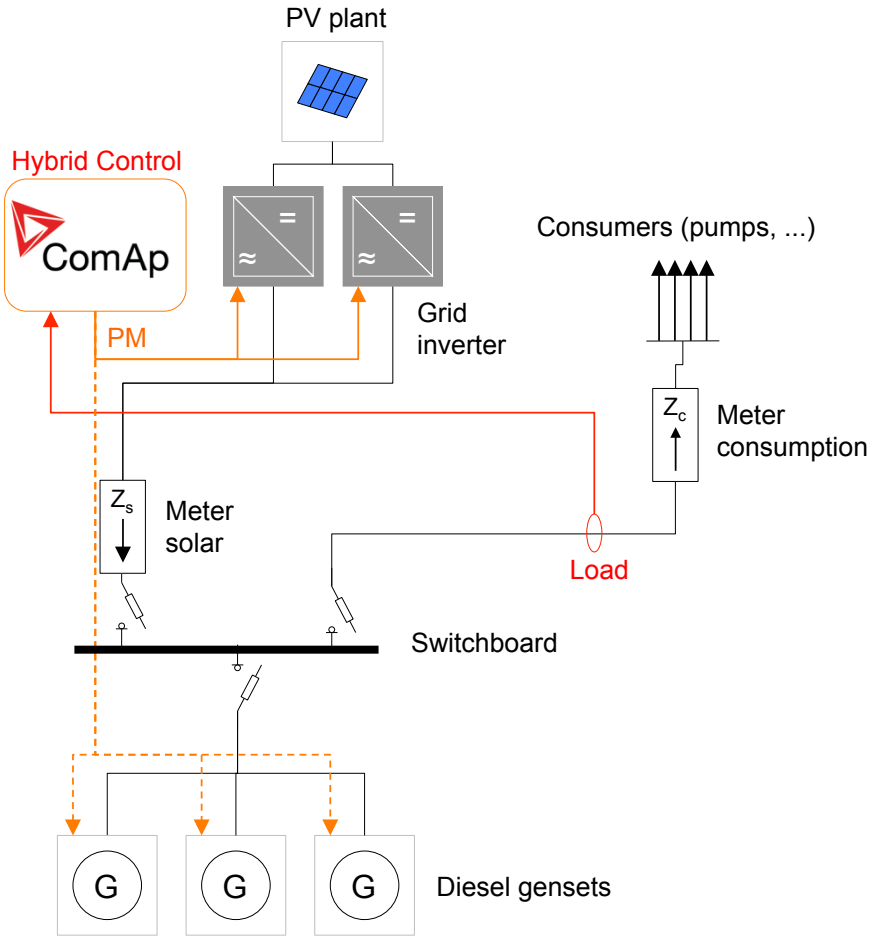
Solar energy is cheaper than unsubsidized diesel



Payback time
~ 5 years

Electrical scheme of PV-diesel hybrid solution

Electrical scheme



Main features of hybrid control

- Hybrid Control ensures stable grid provided by the gensets
- The solar grid inverters only follow the grid
- Control/ measurement of total load
- Regulation of inverter power
  - Power Management (PM) -
  to ensure stable and safe operation of minimum 1 genset
- Genset Spinning Reserve,
  ensuring enough genset capacity available
- Reverse Power Control,
  protection of gensets
- Remote Emergency Control,
  immediate zero-power mode of inverters

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PV plant integrated in diesel grid of luxury hotel

- Luxury hotel in the Atacama Desert, Chile
- Island system supplied by 3 diesel generators
- ~ US$ 100,000 annual diesel costs
- Diesel price of 0.85 US$ per liter

- **Project phase 1: 23 kWp PV plant**
- Feed into diesel grid
- Hybrid controller ensures co-generation
- Commissioned: June 2013

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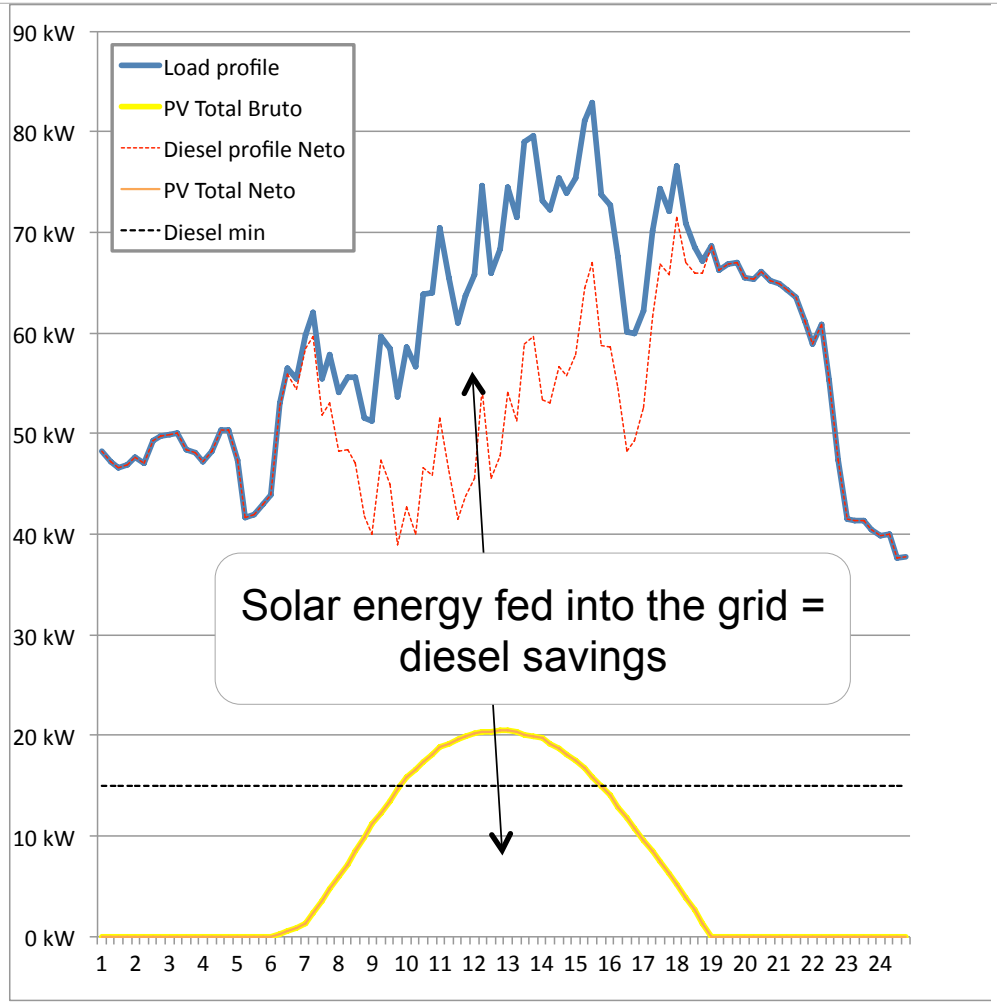
Solar power reduces diesel consumption

Load and solar profiles during one day



- Load profile measurements during project planning
- System solution: integration of PV in diesel grid, min of 1 genset must run continuously
- Diesel savings of ~15% p.a.
- Investment payback in 3 years
- **Project phase 2 (2017):** 156kWp PV / 317kWh Li-Ion battery diesel hybrid system, diesel savings of ~65% p.a.

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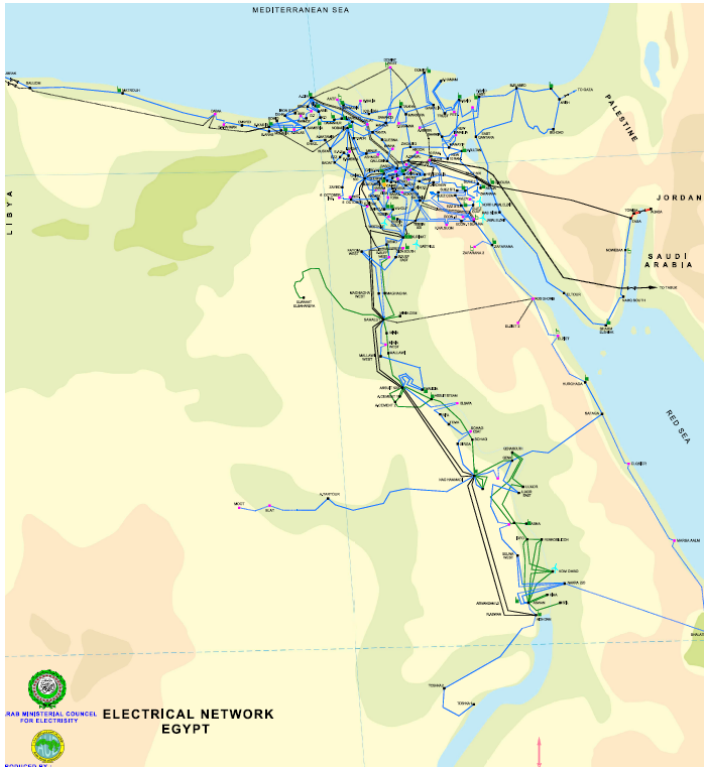
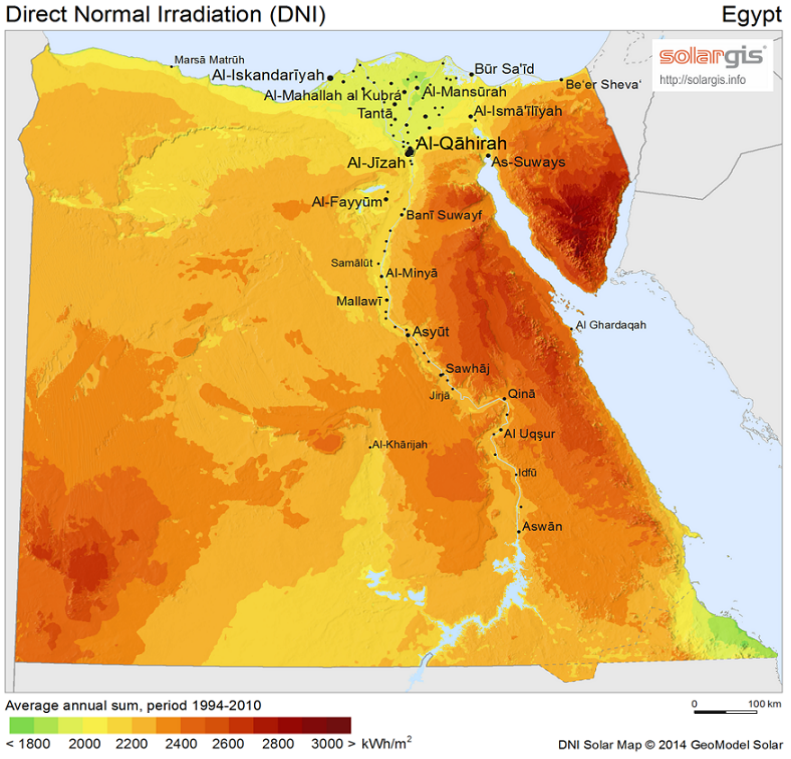
Huge potential for PV-diesel hybrid systems in offgrid agriculture and tourism in Egypt



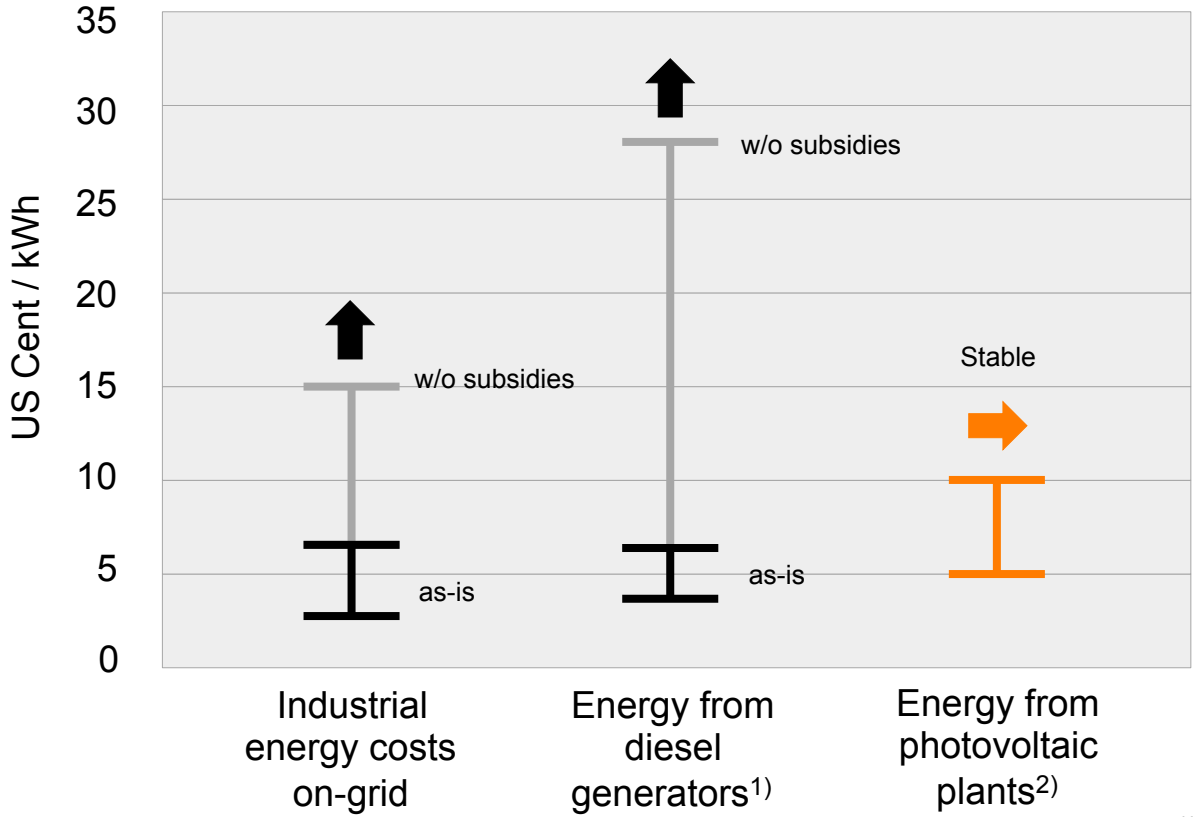


- **Agriculture:** land reclamation, irrigation, livestock breeding, cooling and packaging, ...
- **Tourism:** remote areas such as Marsa Alam, operation of hotels, water desalination, ...

Agriculture and tourism can become drivers of transition to solar power

Solar energy for self-consumption pays off - depending on fossil fuel subsidies, FX rate and capital cost

Comparison of energy costs in Egypt



Implementing solar energy in a business…

- can sink operating expenses
- increases planning dependability
- creates greater independence
- protects the environment

1) Only diesel costs considered: 2.75 EGP/Liter

2) LCOE method, all costs considered over 25 years lifetime: CAPEX, M&O, capital costs

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Market barriers for PV-diesel hybrid solutions in Egypt

Diesel subsidies	Time schedule of phase out is uncertain
Awareness / trust	Local investors, farms, hotels, banks lack know-how and experience
Finance	Unaccustomed cash flows, short investment horizon, weak EGP, high interest rate
Expertise	More complex than solar home systems

Barriers need to be tackled in order to make solar PV successful

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PV-diesel hybrid solutions

Development partnership with GIZ/BMZ

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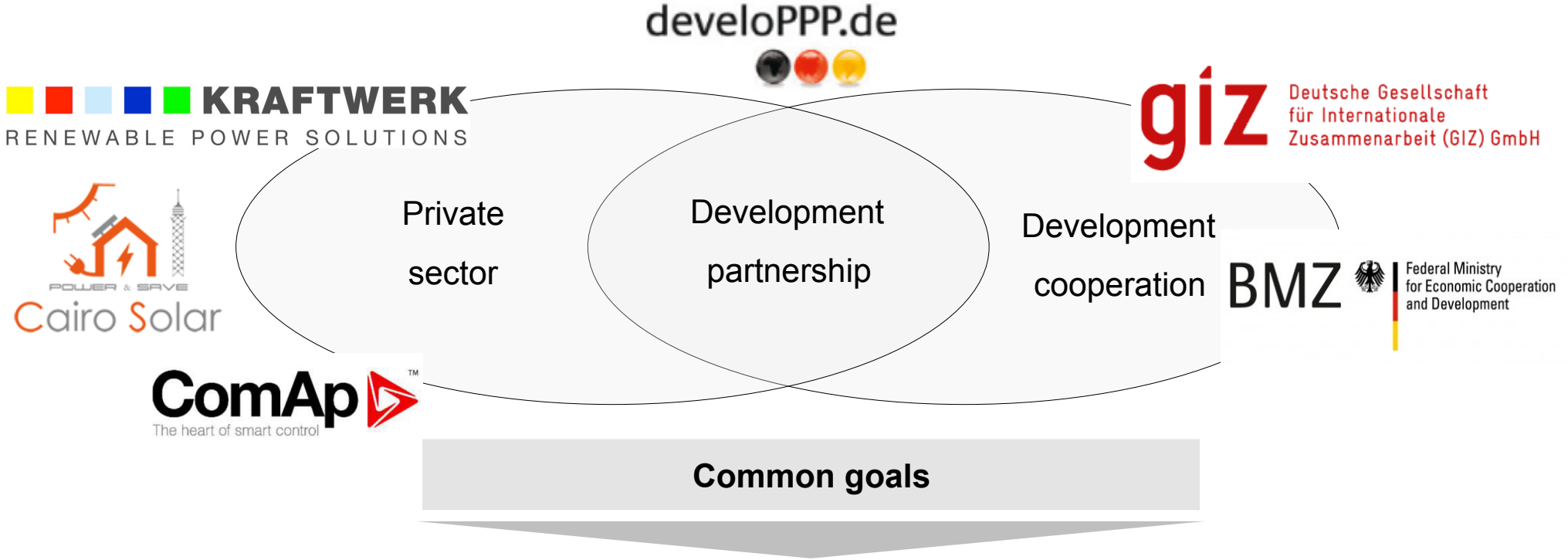

- **Market development** for PV-diesel hybrid solutions in Egypt
- Increase **awareness on reliability and cost-efficiency** of PV-diesel hybrid solutions
- **Target group: local investors and financiers** such as farms, hotels, commercial banks, leasing companies, funds

Planned development partnership activities

Real-world cases	Measurement of load profiles and genset parameters of typical consumers
Toolbox	Financial simulation software and PV-diesel hybrid guidelines
Know-how transfer	Train-the trainer seminars, workshops, trainings
Model projects	Implement and showcase reference PV-diesel hybrid systems
Networking	Connect relevant stakeholders

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Core messages

- PV-diesel hybrid systems have a huge potential in offgrid agriculture and tourism
- PPP with GIZ/BMZ on market development for PV-diesel hybrid systems
- We are looking for interested agricultural and tourism companies, banks, leasing companies, funds
- Kick-off in July 2017: contact us for updates

Thank you for your attention

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