Demonstration PV rural microgrids project in Chad (Central Africa)

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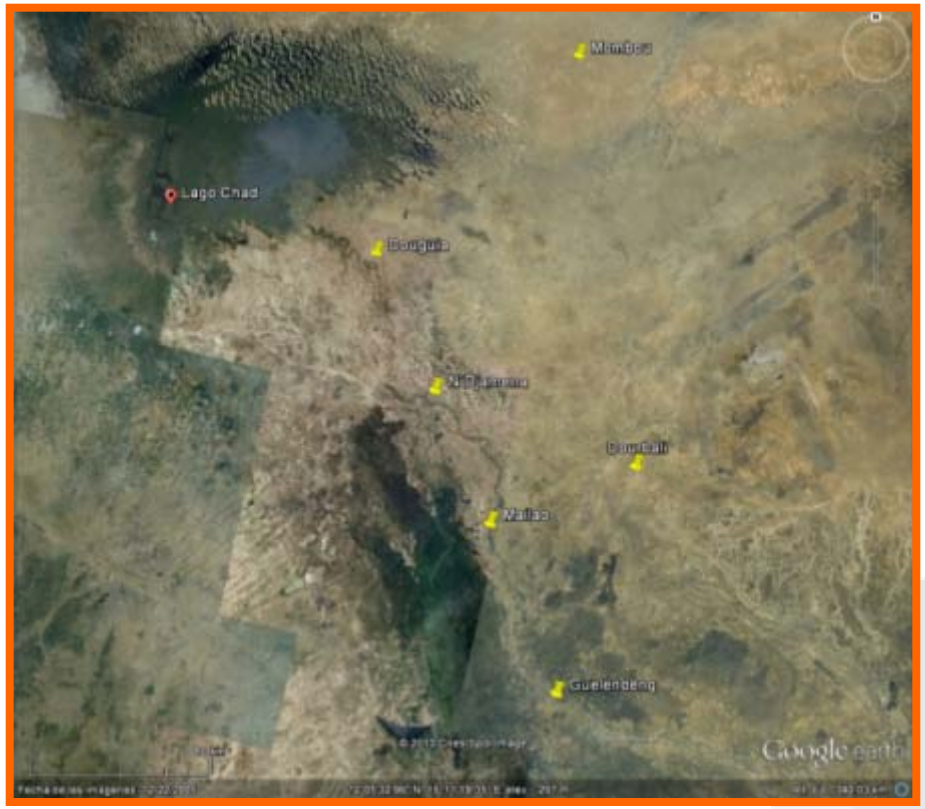
ERDET: Electrification Rural pour le Développement Economique du Tchad



- **Project objectives: to demonstrate and develop enabling conditions for deployment of rural RE microgrids in Chad**
- **Timeframe 2012-2015**
- **5 Villages in different regions**
- **First phase: 3 villages**
- **1 village already commissioned and operating (Mombou) since June 2014**

Developer:

-UNIDO

- MEP

Ministère de l'Energie et du Pétrole

Contractors:

- Trama TecnoAmbiental (TTA), Spain
- Solairechad, Chad
- IDEB , Chad

General Characteristics 3 sites

	DOUGUIA	MOMBOU	GUELENDENG
PV Capacity STC (Wp)	> 40 040	> 39 600	> 32 400
Inverter Power (VA)	36 000	36 000	36 000
Battery Capacity (kWh)	440	440	220
LV Distribution line (km)	2.7	9.7	5.9
Street Lights	19	19	36
Back up Diesel Genset (kVA)	50	50	50
Consumer Connections Target	54	138	27
Total potential buildings estimate	800	200	2500

First phase 3 villages:

Mombou operating since June 2014, Guelendeng and Douguia planned for January 2015

Issues considered

- **Technical issues:**
  - Scope and boundary of the service scheme
  - Demand characterisation and technical solution
  - Metering concept
  - Local Capacity Building

- **Financial issues:**
  - Public / private investment
  - Business model
  - Tariffs

- **Regulatory issues:**
  - Community/local vs national framework
  - Cost based tariffs

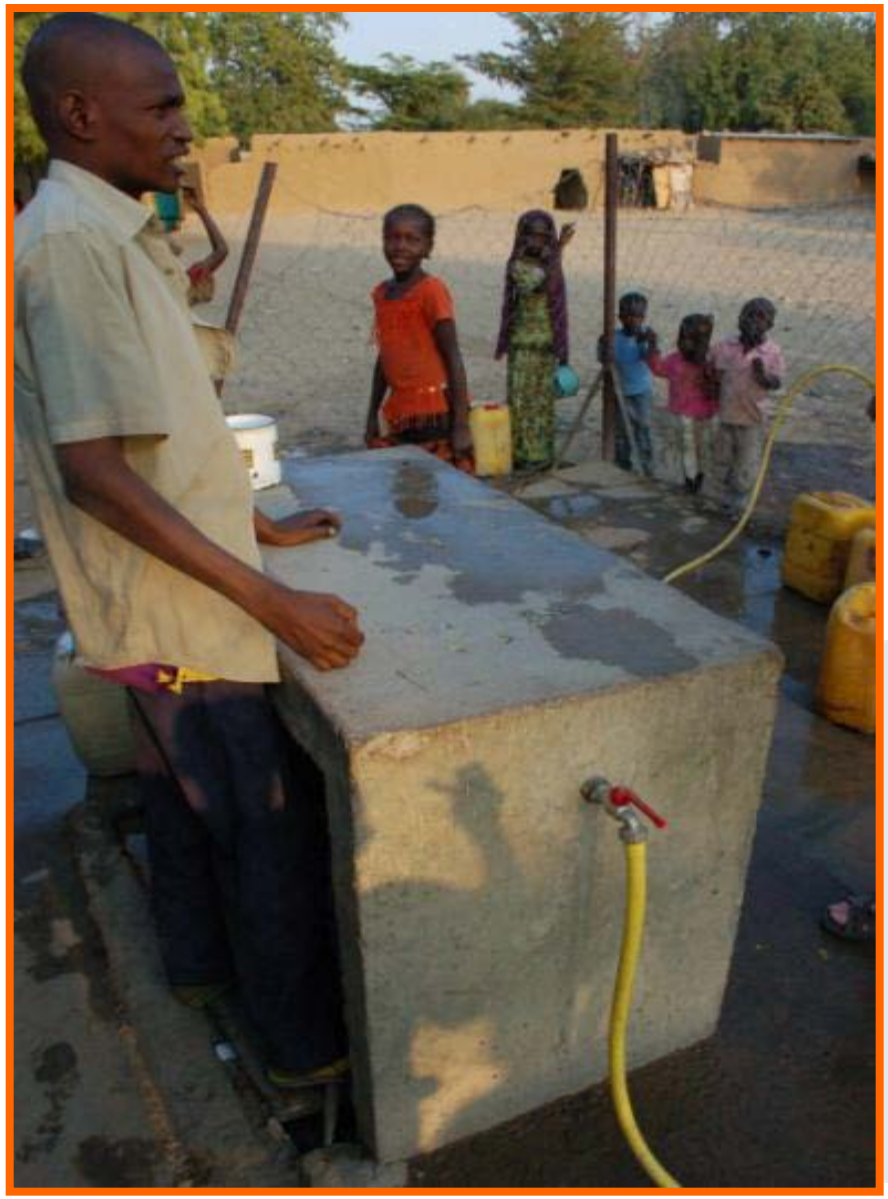
Mombou: the village

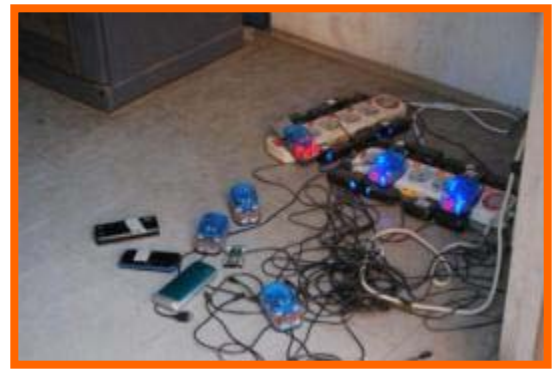
- Remote in semiarid climate
- 800 people and an additional 200 from hamlets nearby, main income generating activity is cattle
- 135 buildings (129 connected), school, medical centre, mosque, small shops
- several small shops, water pumps for vegetable gardening
- Deferrable load: water pumping for irrigation
- PV electricity since June 2014

Needs Assessment and development of operation scheme

1. Load estimates
2. Ability and willingness to pay
3. Socio economics of the community
4. Reference community resource management: water

Needs Assessment and development of operation scheme



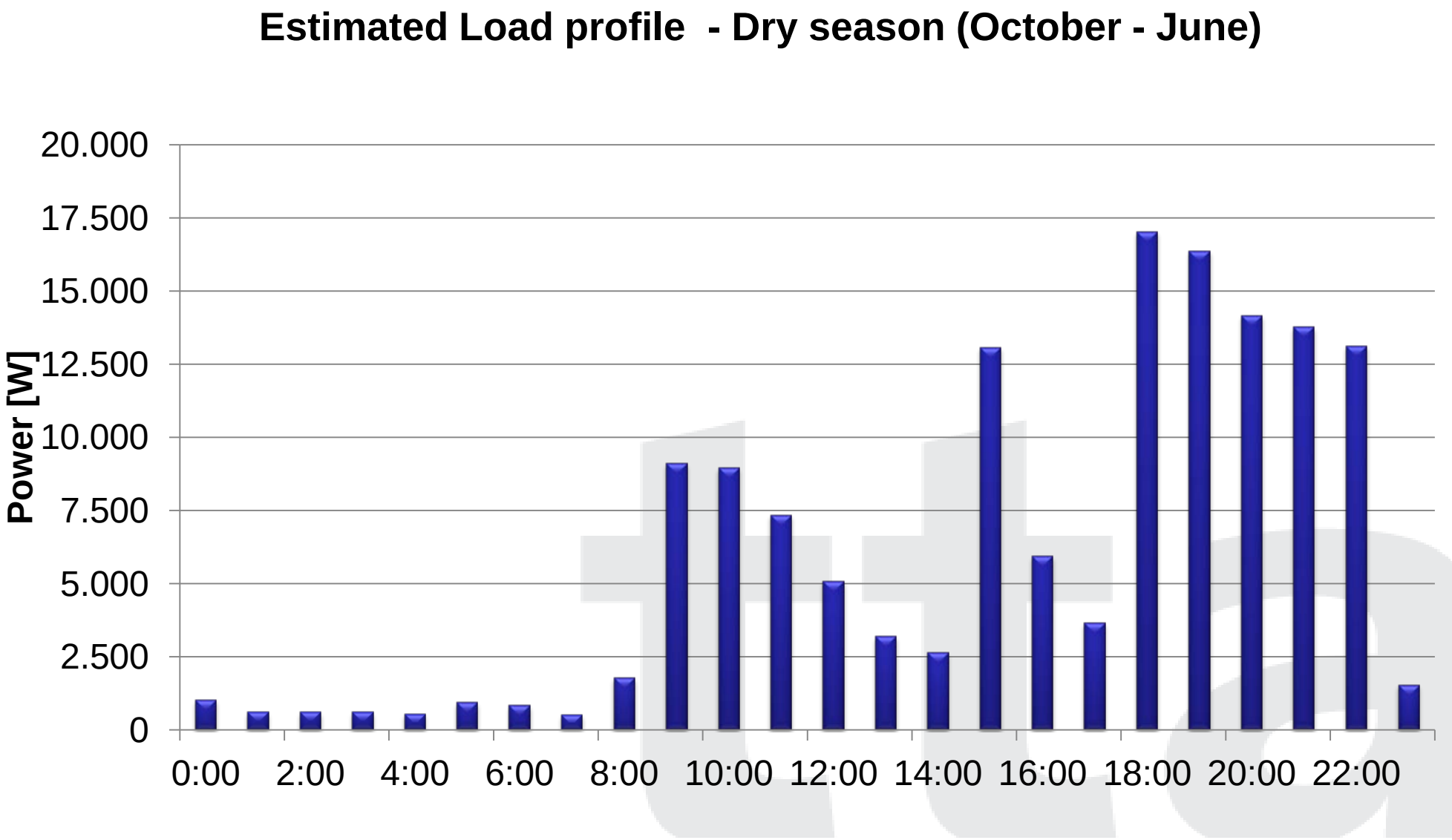


Needs Assessment and development of operation scheme

Year 1: TTA has temporary concession to develop and test private/community model

After year 2: to be decided

Needs Assessment



Design Criteria

1. High Penetration PV:

- ✓ Diesel Genset as back up
- ✓ Assume 30% demand growth in 10 years
- ✓ Big battery capacity (1 to 2 days autonomy)

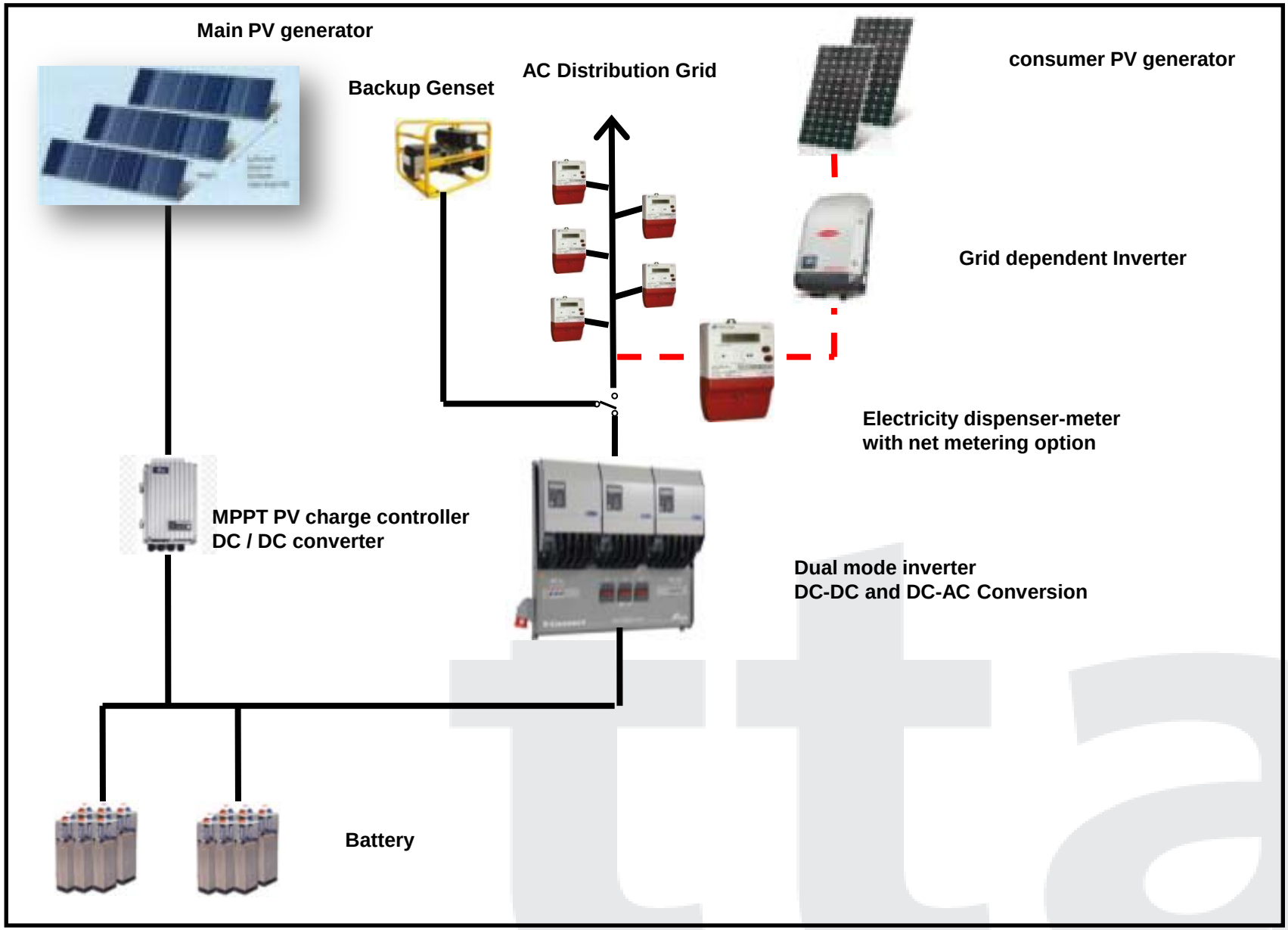
2. Robust solution adapted to load profile and environment :

- ✓ DC coupling at ELV
- ✓ to manage each user's energy in an independent way
- ✓ to guide users' energy consuming habits to optimize energy management
- ✓ Flat tariffs based on EDA (Energy Daily Allowance)
- ✓ Standard AC distribution grid

3. Community involvement:

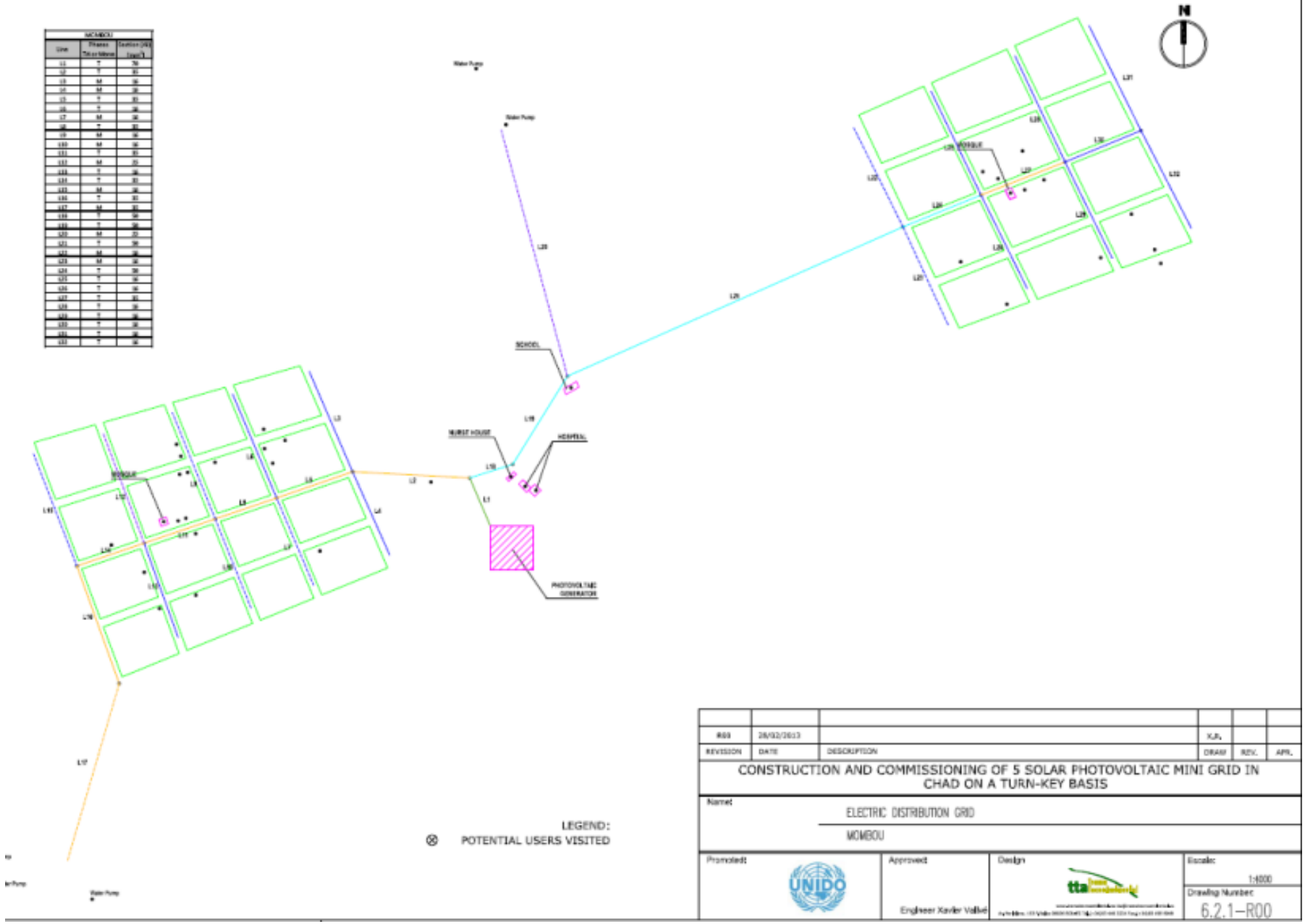
- ✓ During the design and construction
- ✓ As part of the operational scheme
- ✓ Potential for future user owned distributed PV generation

Electrical diagram



Distribution grid layout

Mombou, Chad



Technical Specifications Mombou

· MOMBOU MSG	
· MAIN CHARACTERISTICS	
Owner	UNIDO / MEP
Contractor and Operator	TTA and Local Association
Electrical service	24 h/day, 230 V/400V three-phase
Number of user connections	129 (135 potential)
Public street lighting	yes
Type of tariff	Energy Daily Allowance (EDA)
Demand growth factor	30%
Rated Average Solar Daily Yield	140,4 kWh/day – 5,91 HPS
PV GENERATOR	
Total PV capacity (STC)	39.600 kWp
Type of PV module / capacity STC	polycrystalline / 240 W_p
Brand and Model	REC240PE
Number of PV module	165
Inclination / orientation	10º / +25º S
EMERGENCY GENSET	
Brand and Model	FG Wilson P50-1
Nominal power	50 kVA
BATTERY	
Technology	Lead acid deep cycle OPzS
Brand and Model	Hoppecke 24 OPzS 3000 rated at 4 464 Ah (C100)
Rated Voltage	48 V
Total / Practical capacity (-70%) (C_{100})	434 kWh / 304 kWh
DUAL-MODE INVERTER	
Brand and Model	Studer-Innotec XTH 6000-48
Number of inverter	6
Total rated power (5" – 30')	90 000 VA – 36 000 VA

DATA LOGGER and CONTROL	
Price signal broadcast	Frequency
Type of data	Energy, voltage, temperature, radiation , etc.
Remote access	GPRS
ELECTRICITY DISPENSER – ENERGY METER	
Power supply	230 V_{CA} 50 Hz
Model	CIRCUTOR Electricity Dispenser BII
Algorithm	Energy Daily Allowance (EDA) configurable
PUBLIC STREET LIGHTING	
Type of lamp	36 W LEDs and 23 W CFL
Number of lamp	17 (11 poles and 6 wall)
DISTRIBUTION LINE	
Type of cable	Aluminium XPLE
Length of line	10200 m
Type of distribution	Underground

EDA (Energy Daily Allowance) service tariffs applied

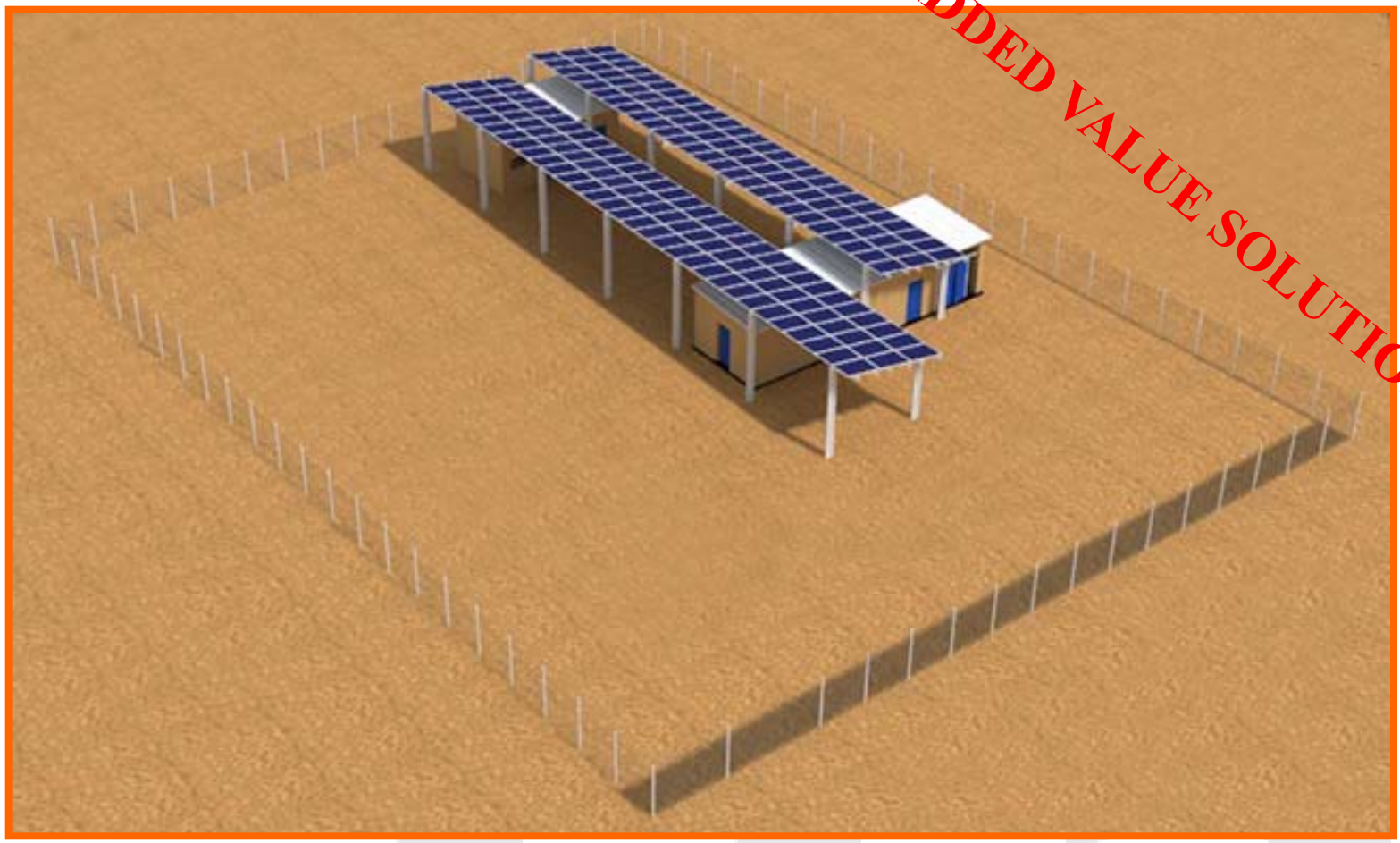
Flat monthly tariff according to EDA, power limit and virtual energy storage

Tariffs			
code	Monthly fee (CFA)	EDA (Wh/day)	Maximum power (kW)
T11	4.100	550	0,5
T21	11.200	1.100	0,5
T41	22.000	2.200	0,5
T72	38.600	3.850	1,0
T82	43.900	4.400	1,0

Implementation

PV Generator Structure: pergola

ADDED VALUE SOLUTION



Advantages:

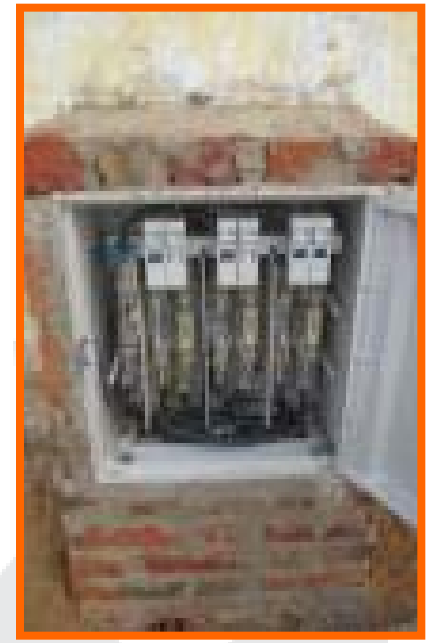
- **Better use of plot of land**
- **To create a shaded area for possible association / public activities**
- **High PV modules - reducing risk of vandalism**

Added value solution: PV pergola

Added value solution: local capacity building

Technical solution: mechanical room

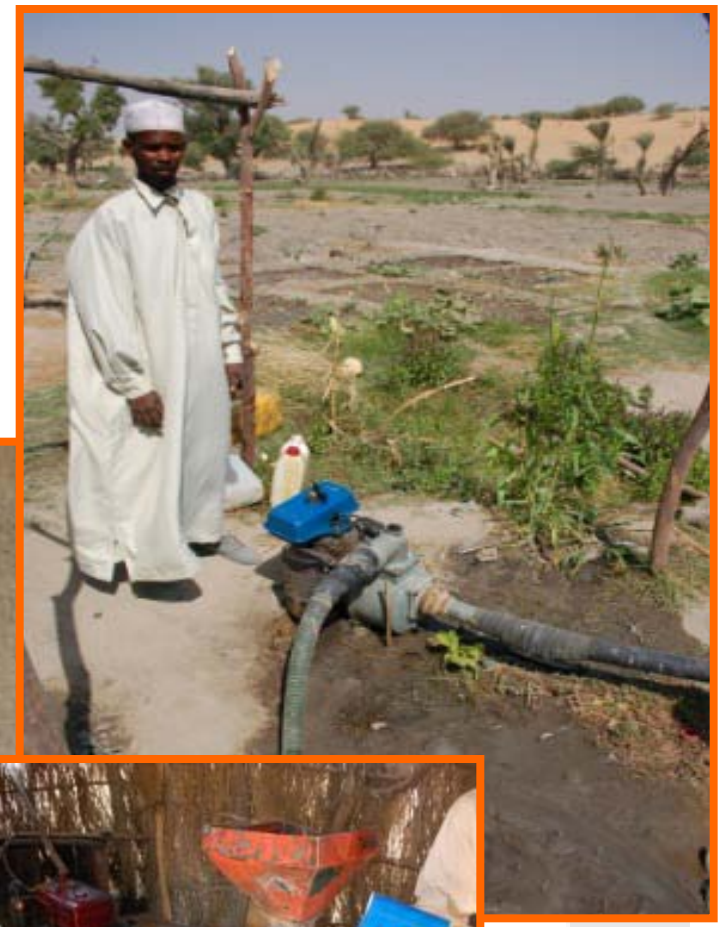
Technical solution – three phase LV distribution



Added value solution: Engage the users

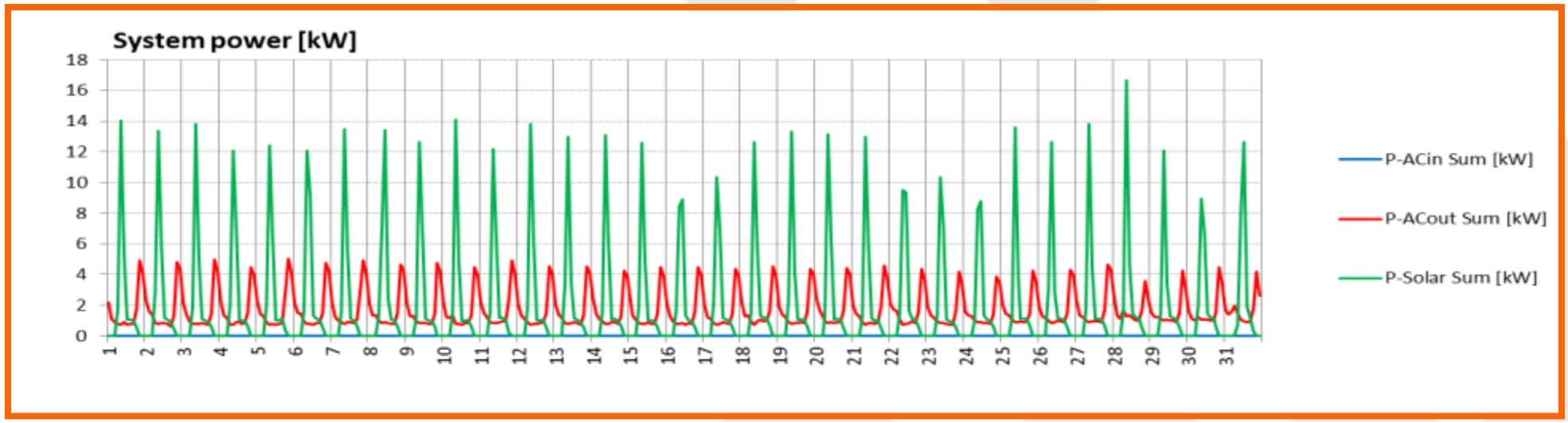
Added value solution: deferrable consumptions

income generation activities

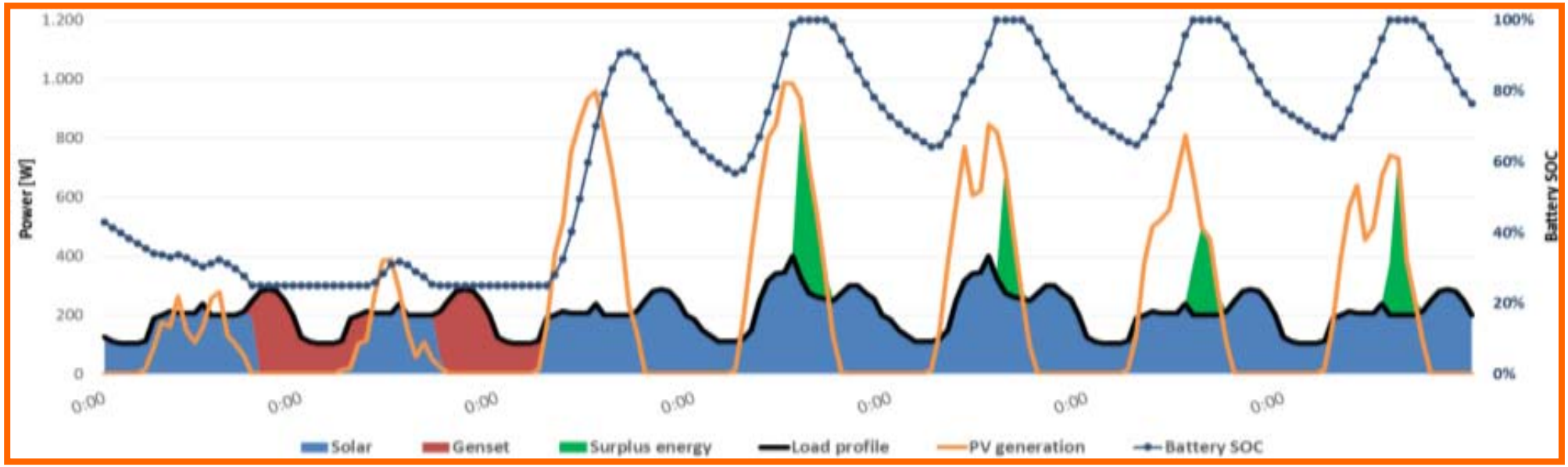


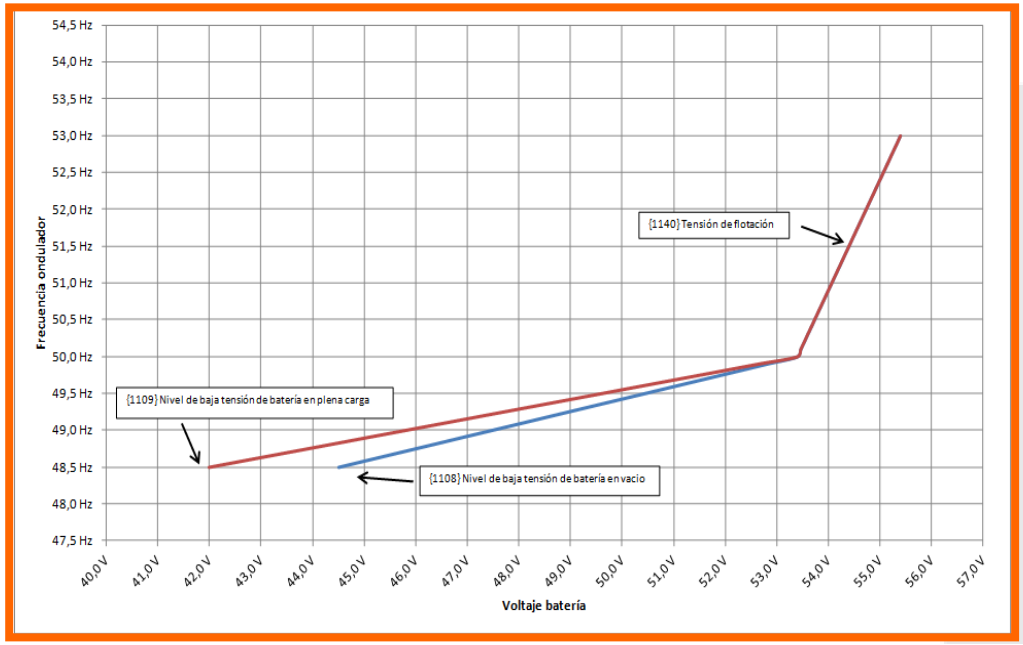
User interface: Electricity dispenser essential for load control

Energy Cap (EDA); price signal (green/red LED); auxiliary smart switch

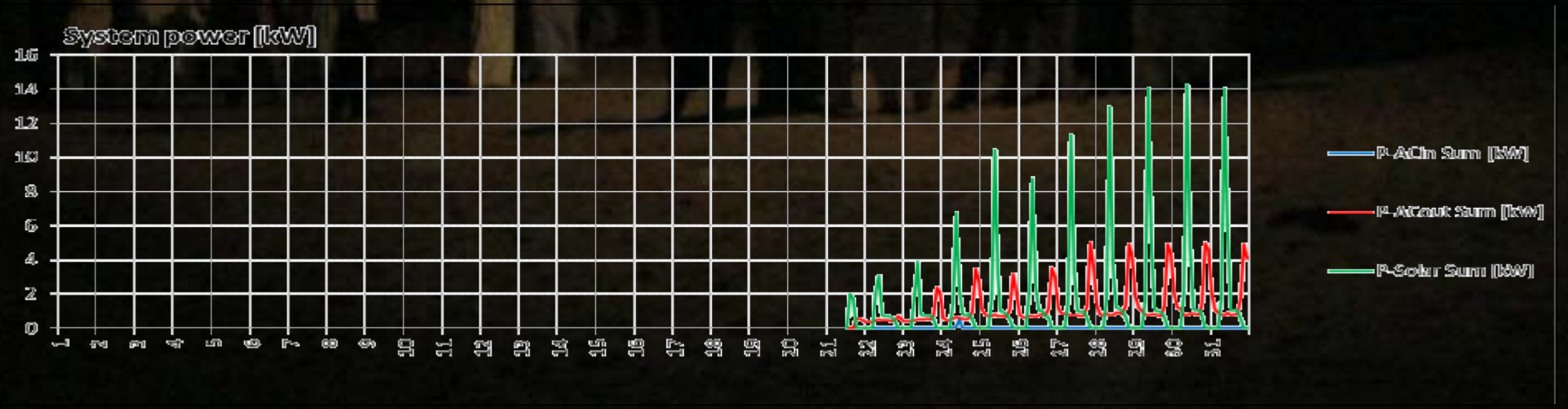


Real time price signal through frequency





Start up: Let there be light!



Thank you for your attention!