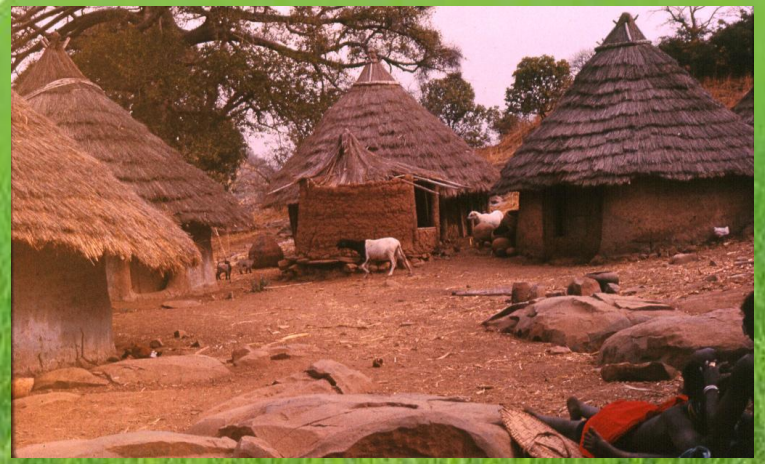
Solar PV on Every Rooftop

PV PREDICT

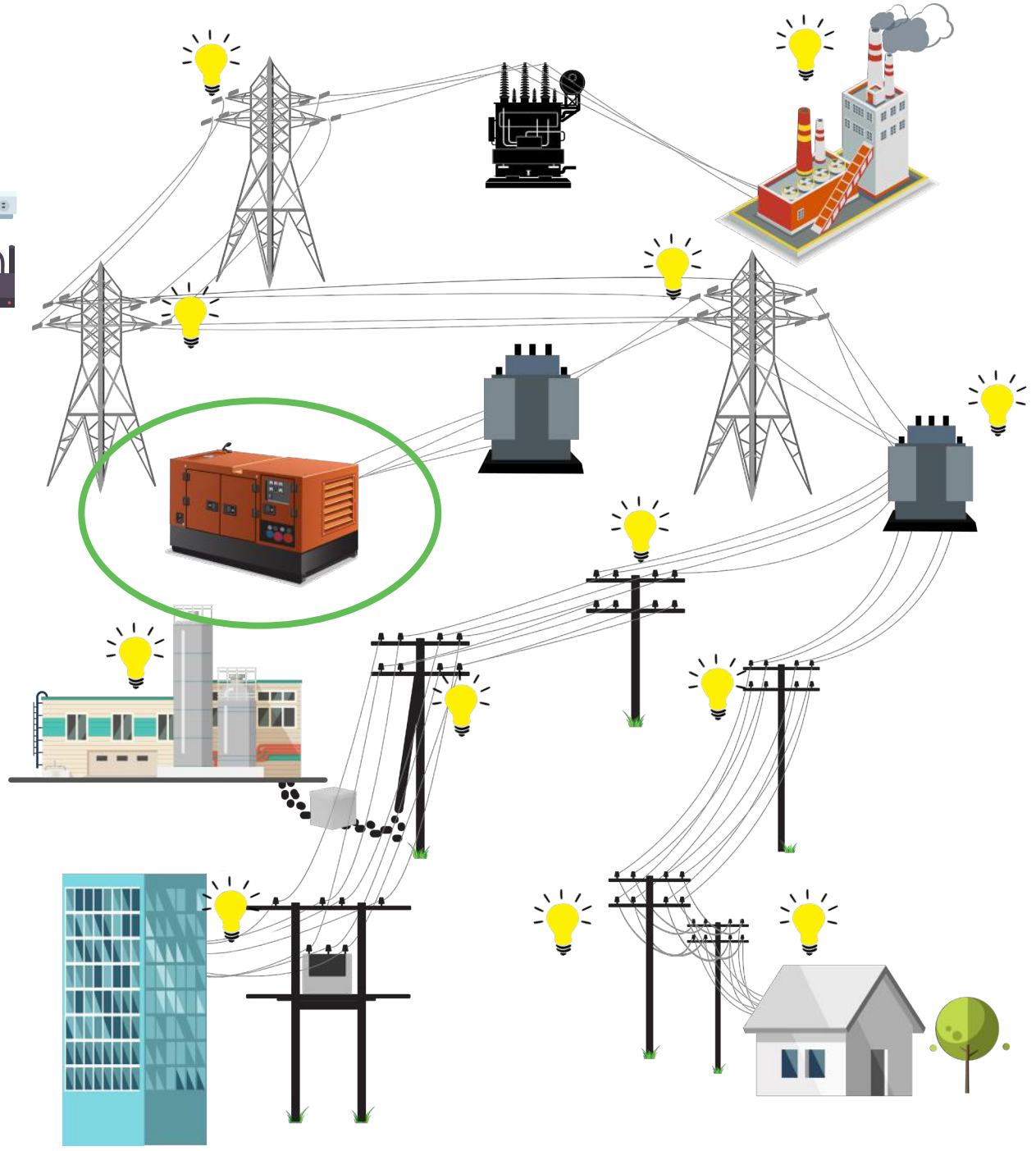


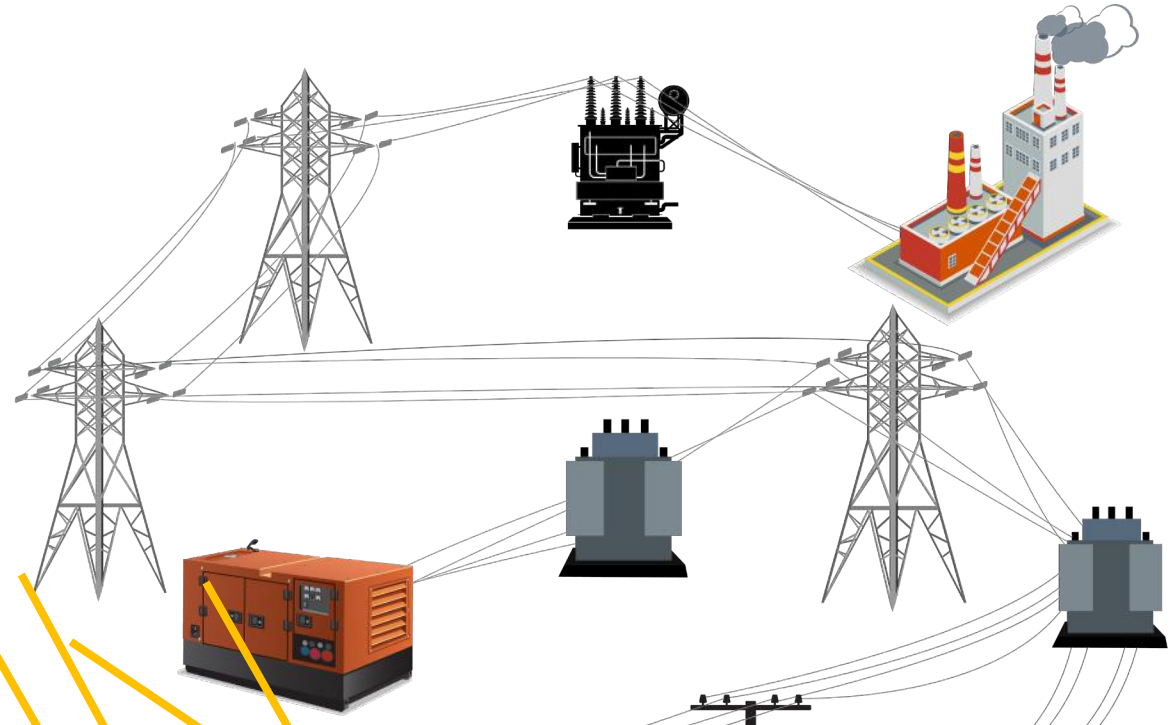
Smoothing the wrinkles in the distributed generation electrical grid

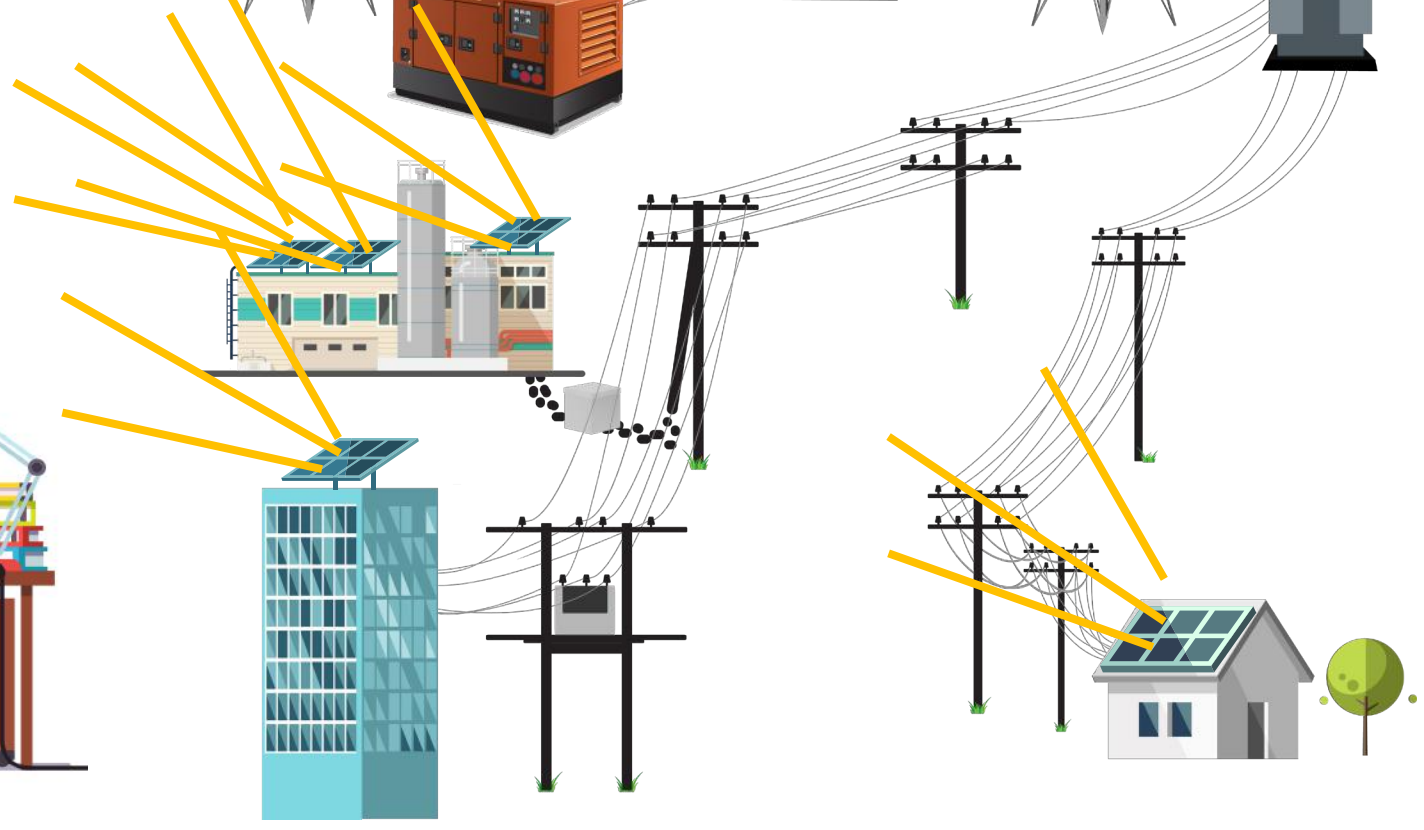
A Technology Transfer

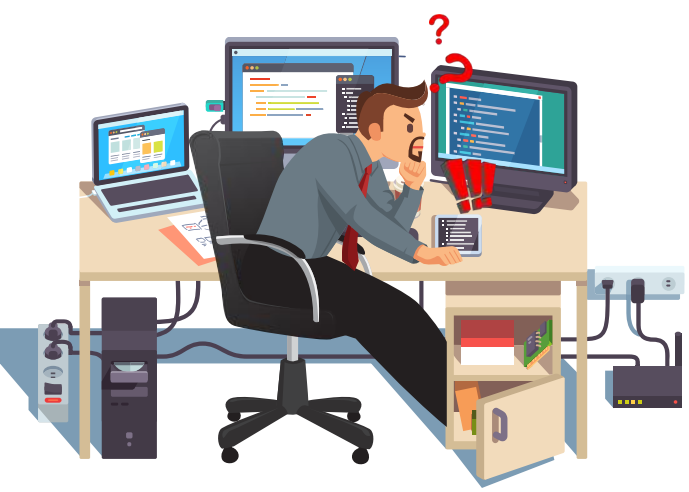
3rd World problems: Underserved or no grid

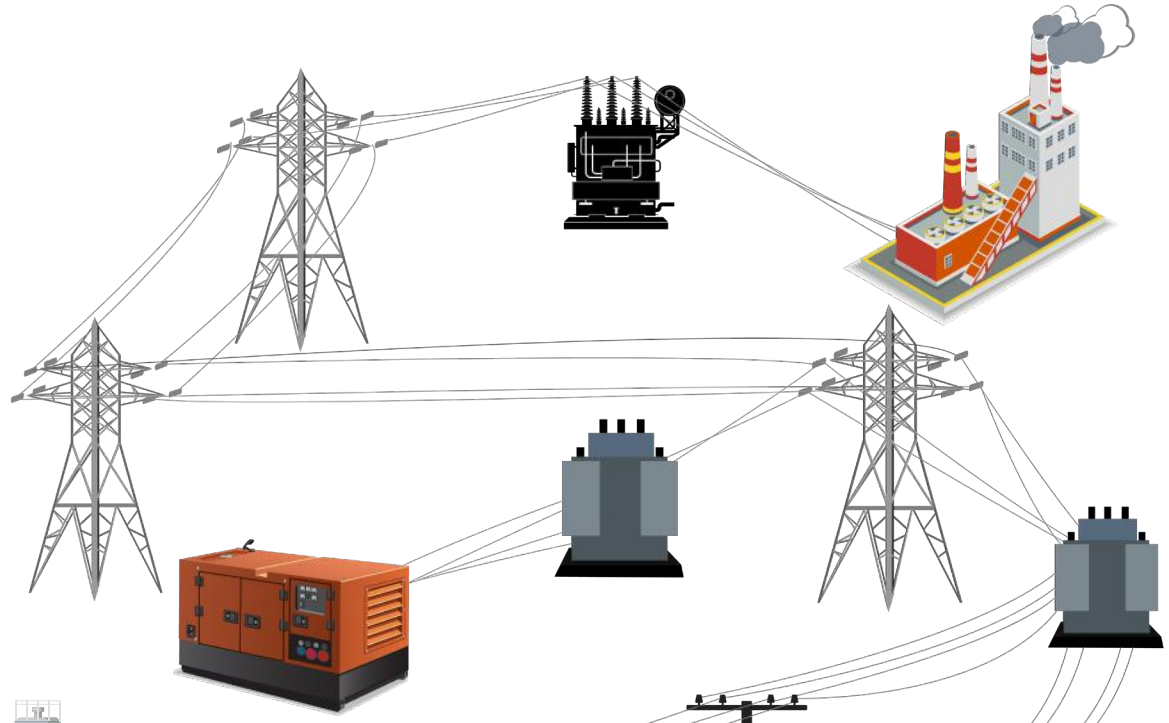
1st World problems: Distributed Energy (DER) management

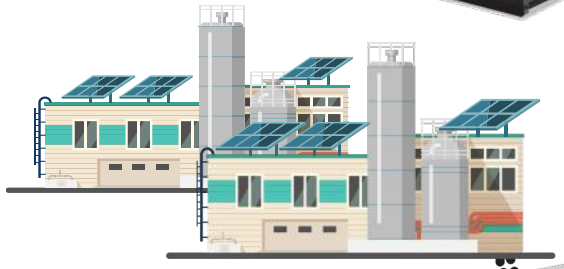


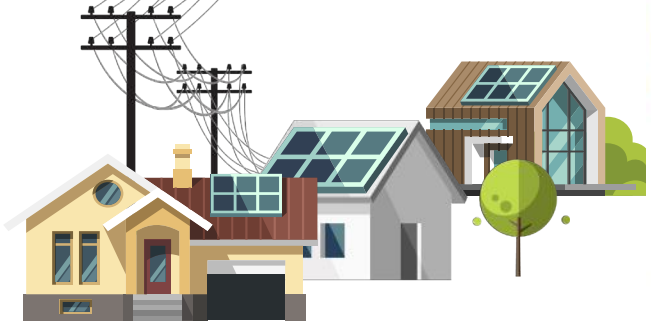








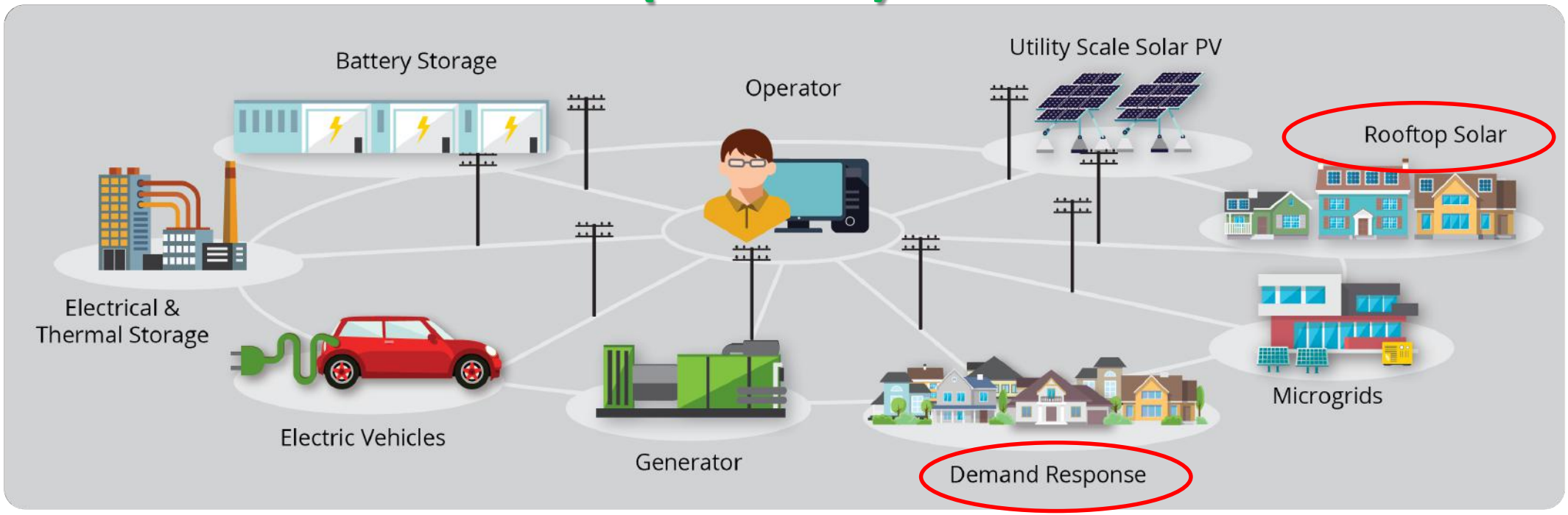





GRID INSTABILITY!!!


Inconsistent generation
Low Availability & Lack of Efficiency
Uni- directional Grid
Costly Spinning Reserve
Voltage Fluctuation
Over Voltage
Spot Market Losses

Distributed Energy Resource Management (DERMS)



Demand side vs. Supply side

DERMS development: Solar-Era.NET

High PV Penetration – Pilot Project

Distributed Energy Resource Management System - DERMS

Cyprus – an EAC managed neighborhood LV distribution grid

Grid management program:

1. **Reduce spinning reserve**
2. **Manage voltage levels on the grid**
3. **SoH for system owners**

High PV Penetration – Pilot Project

Distributed Energy Resource Management System - DERMS

Israel – a kibbutz managed neighborhood LV distribution grid

Grid management program:

1. **Manage voltage levels on the grid**
2. **SoH for system owners**

Ready for Market

Prediction / SoH Software

Site Daily Production for date: 06/11/2018 00:00:00

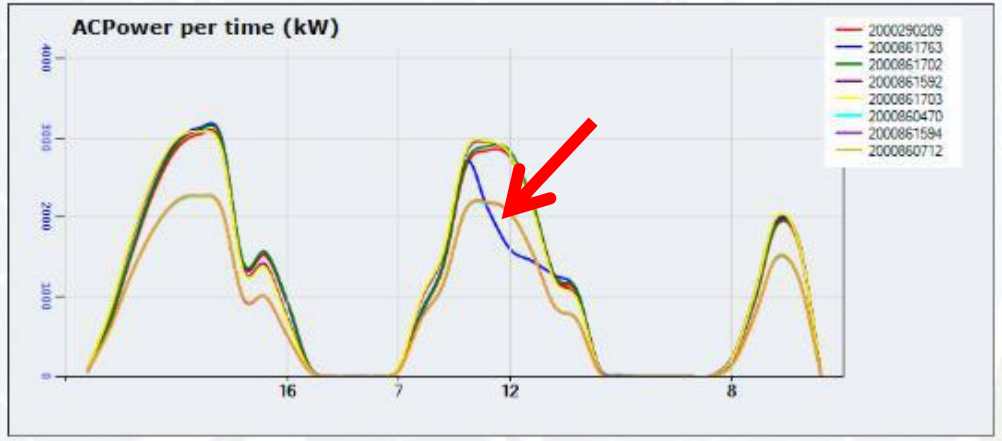
InverterId	InverterName	Production	Prediction	PR	Relative	Health	CO2	Earn
2000290209	Inverter B	5.53	21.03	0.00	D	*	5.20	0.00
2000860470	Inverter G	4.23	17.73	0.00	A	*	3.98	0.00
2000860712	Inverter I	4.24	17.35	0.00	A	*	3.99	0.00
2000861592	Inverter E	5.82	20.64	0.00	C	*	5.47	0.00
2000861594	Inverter H	4.29	17.52	0.00	A	*	4.03	0.00
2000861702	Inverter D	5.64	25.13	0.00	D	*	5.30	0.00
2000861703	Inverter F	5.82	23.02	0.00	C	*	5.47	0.00
2000861763	Inverter C	5.68	22.07	0.00	D	*	5.34	0.00
*	Total	41.24	164.49	0.00			38.78	0.00

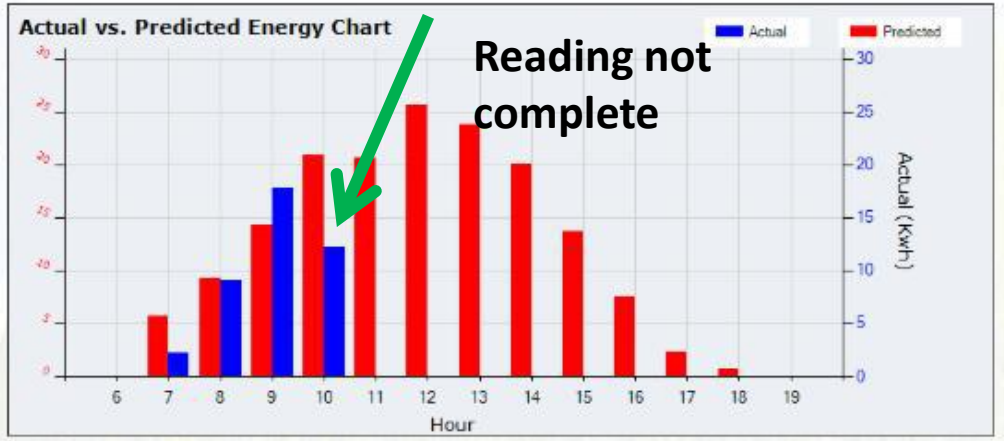
download file here

Today's Date 2018-11-06

Click date to display data

Inverter	Health History Old->New 15 days
Inverter B	CBCBAAAAAAAACDF
Inverter G	DBCCAAAAAAABCDF
Inverter I	CABBAAAAAAAACDF
Inverter E	BABBAAAAAAAACDF
Inverter H	DACCAAAAAAAACDF
Inverter D	DBBCAAAAAAACCDF
Inverter F	CBCCAAAAAAAACDF
Inverter C	CAADAAAAAAAABDF





Ready for Market

Prediction / SoH Software

Site Daily Production for date: 05/11/2018 00:00:00

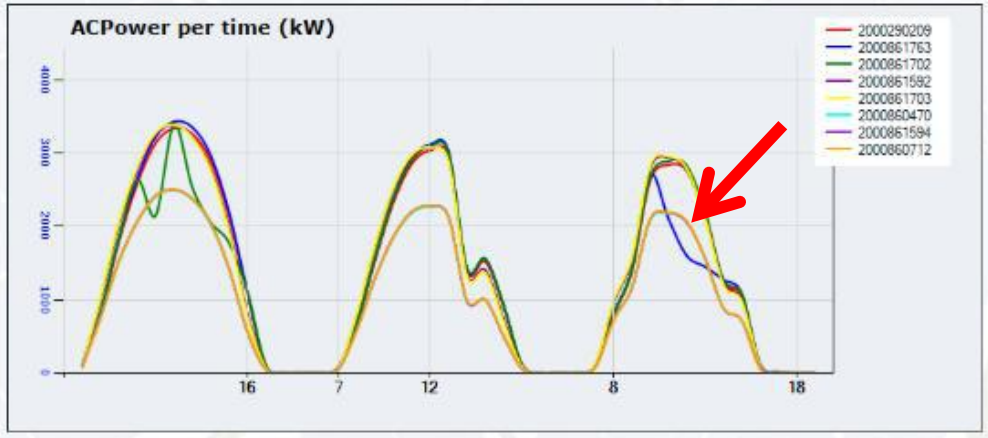
InverterId	InverterName	Production	Prediction	PR	Relative	Health	CO2	Earn
2000290209	Inverter B	19.93	23.17	0.00	D	D	18.73	0.00
2000860470	Inverter G	15.17	17.42	0.00	A	D	14.26	0.00
2000860712	Inverter I	15.25	16.98	0.00	A	D	14.33	0.00
2000861592	Inverter E	20.58	23.37	0.00	C	D	19.35	0.00
2000861594	Inverter H	15.28	16.87	0.00	A	C	14.36	0.00
2000861702	Inverter D	20.28	23.59	0.00	D	D	19.06	0.00
2000861703	Inverter F	20.64	23.13	0.00	C	D	19.40	0.00
2000861763	Inverter C	16.76	19.67	0.00	F	D	15.75	0.00
*	Total	143.89	164.19	0.00			135.24	0.00

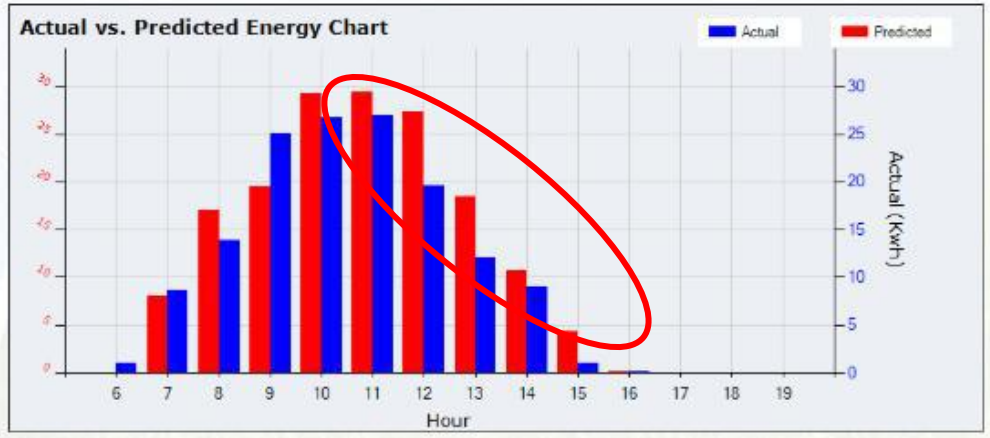
download file here

Today's Date 2018-11-06

Click date to display data

Inverter	Health History Old->New 15 days
Inverter B	CCBCBAAAAAAAACD
Inverter G	CDBCCAAAAAAABCD
Inverter I	CCABBAAAAAAAACD
Inverter E	BBABBAAAAAAAACD
Inverter H	CDACCAAAAAAAACC
Inverter D	CDBBCAAAAAAACCD
Inverter F	CCBCCAAAAAAAACD
Inverter C	ACAADAAAAAAAABD
	F





Grid Location / Management Software

Regulatory Difficulties….

Grid management programs:

1. **Require the cooperation of the various operational departments**
2. **Require authorization of upper management**
3. **Require supporting regulatory atmosphere**

With all the good intention from all involved parties, introducing a new system is not easy

Electricity in Africa

- On average < 50% have access to grid
- The grid does not always have power….
- “Growing out the grid” … ?

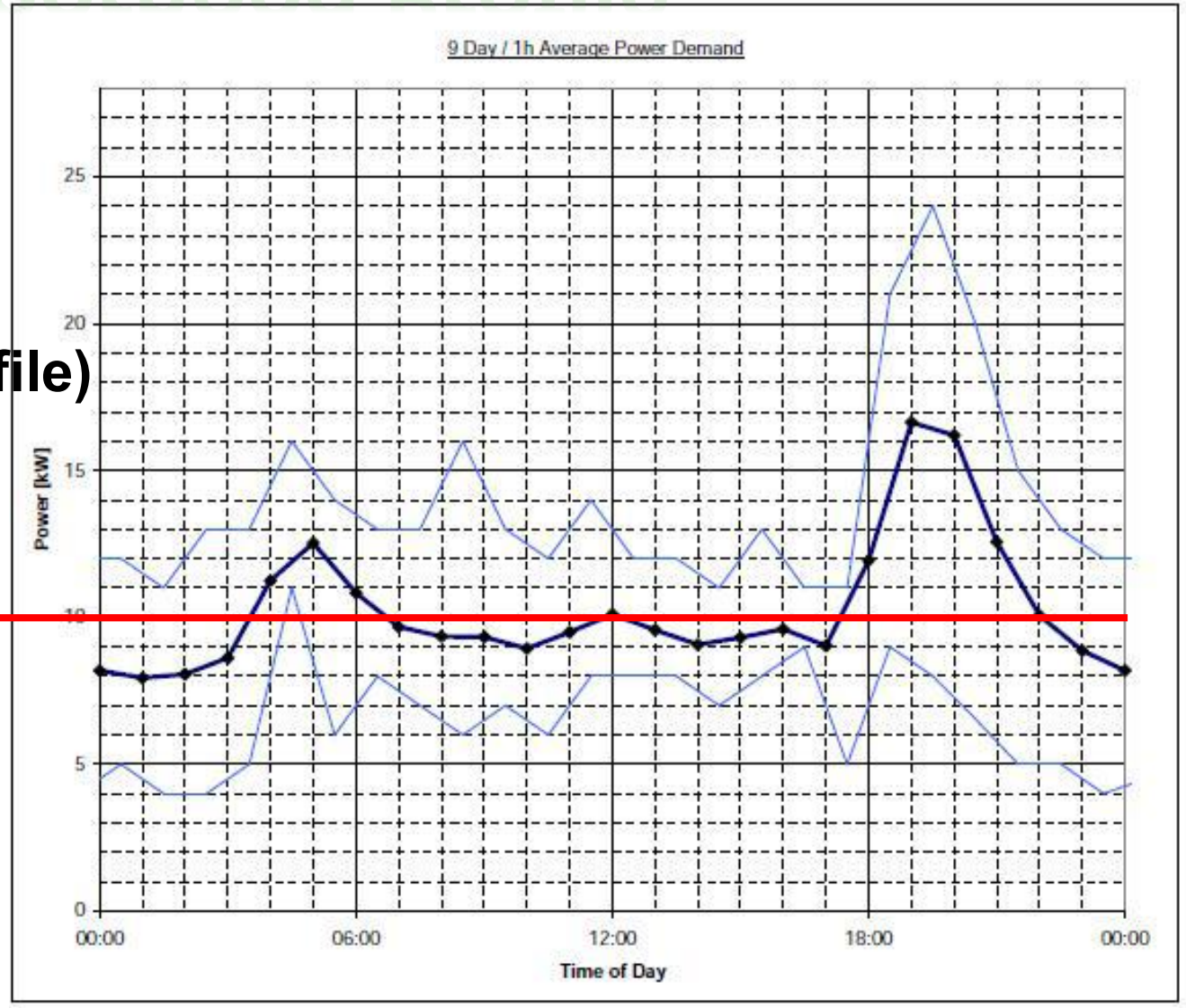
  <u>Too little to late at too high a price</u>

Electricity in Africa

- **Micro grids – the answer?**

Neighborhood Profile

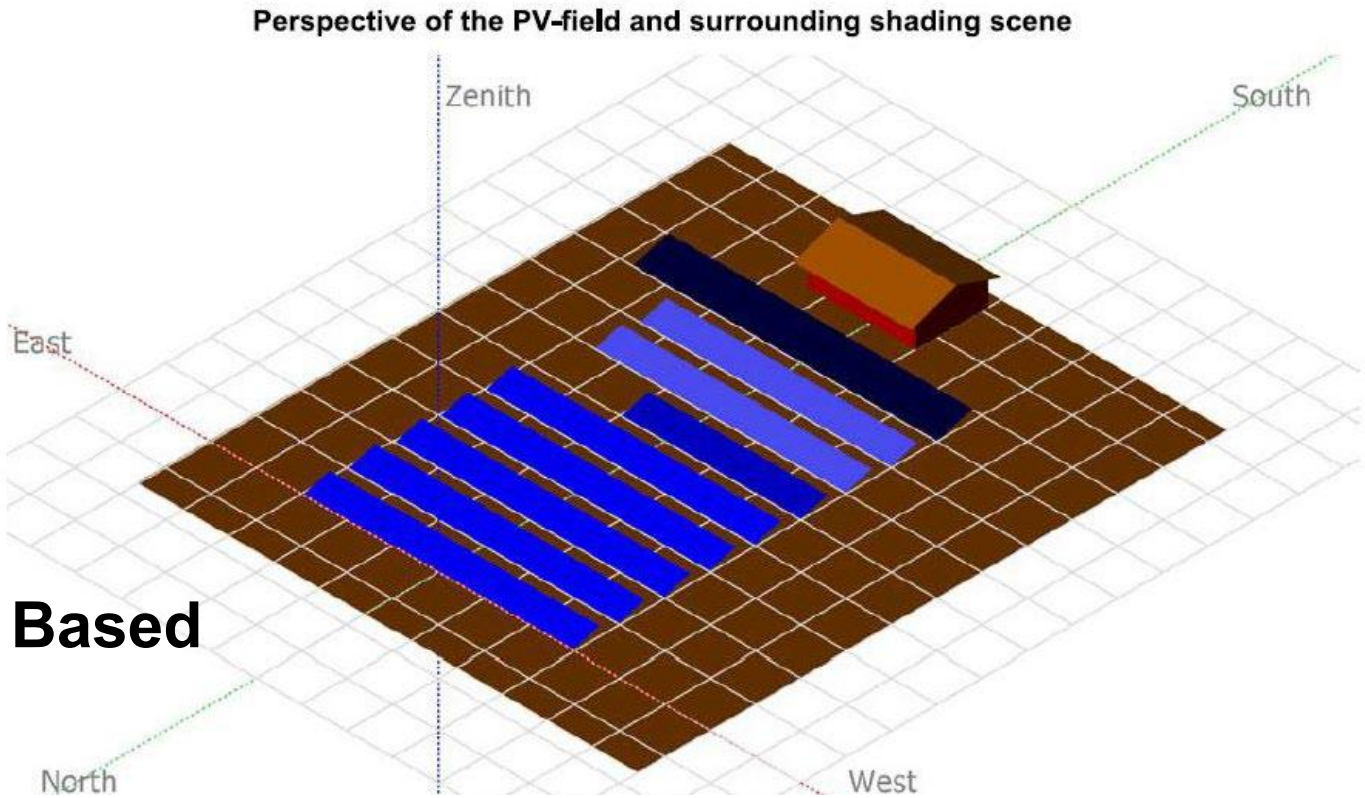
- 150 families
- Trade type consumers (tailor, shoemaker, grocer)
- +16 kW maize mill (not in profile)
- Licensed by regulator
  - $0.12/kWh
- Unregulated
  - $0.29-0.45/kWh



A Neighborhood Generator

- 60MVA generator; off grid solar with backup
- 150kWp of solar modules
- 9,000 Ah @ 48Vdc (14 tonnes)
- 1 day autonomy
- Cost of building out a grid ~$600/dwelling

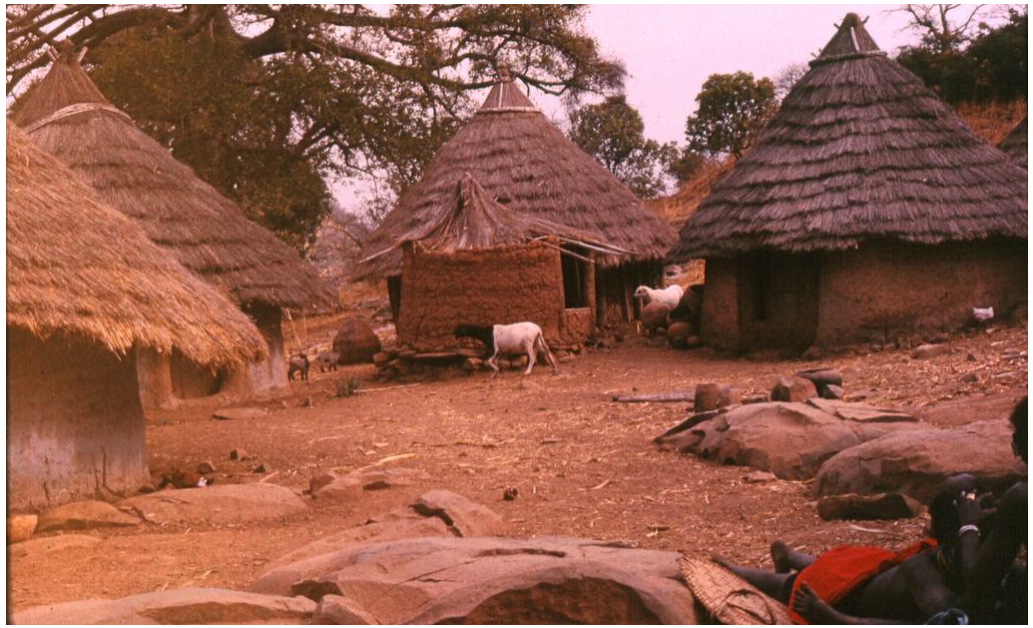
How do we size conductors? Based on the current load profile?



Electricity in Africa

The Grid is quickly out-dated….

The Current Trend: “Home Solar”



Home Solar installed by an “off-grid Utility”

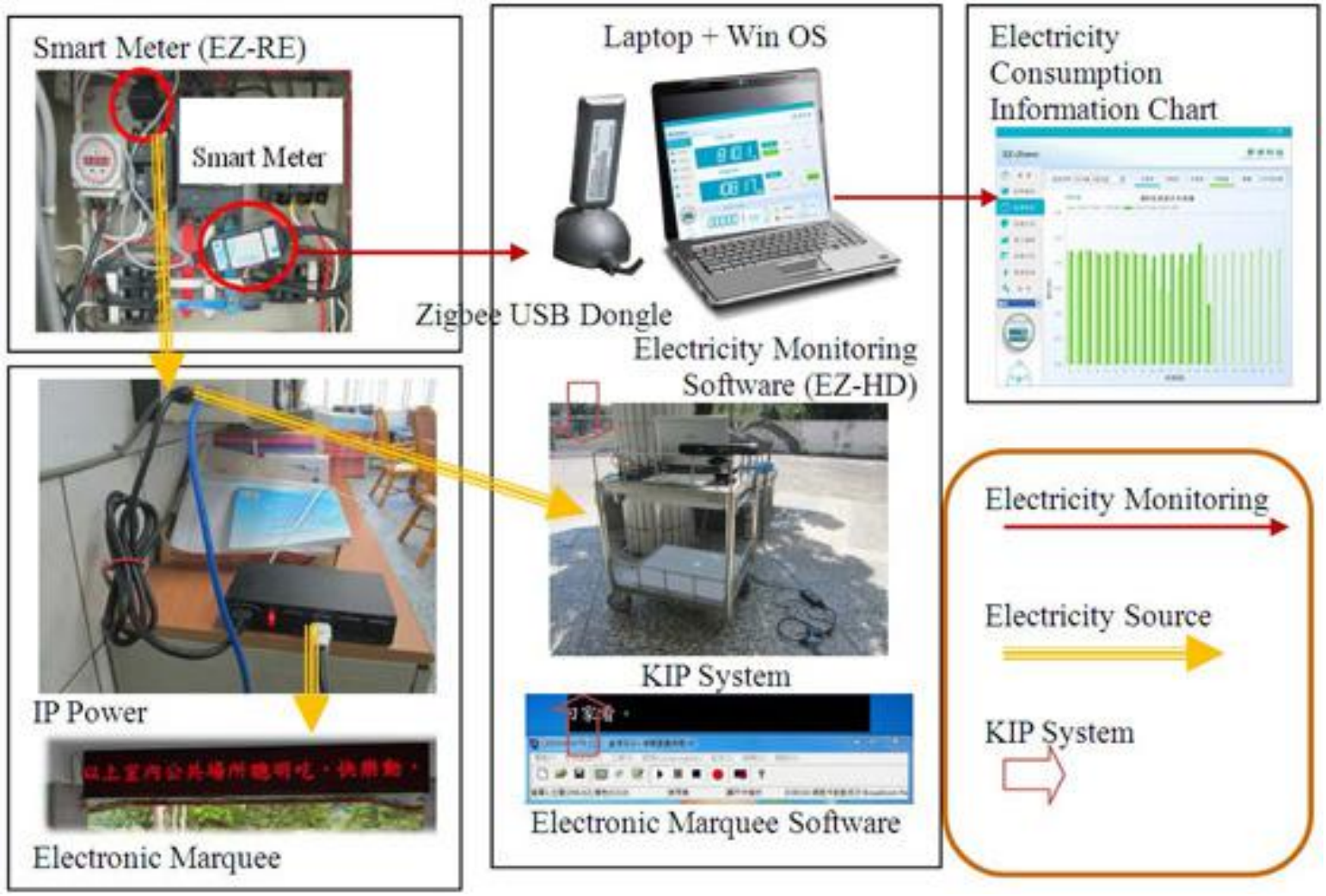
- **“Paygo” mechanism**

The Power of a Utility….

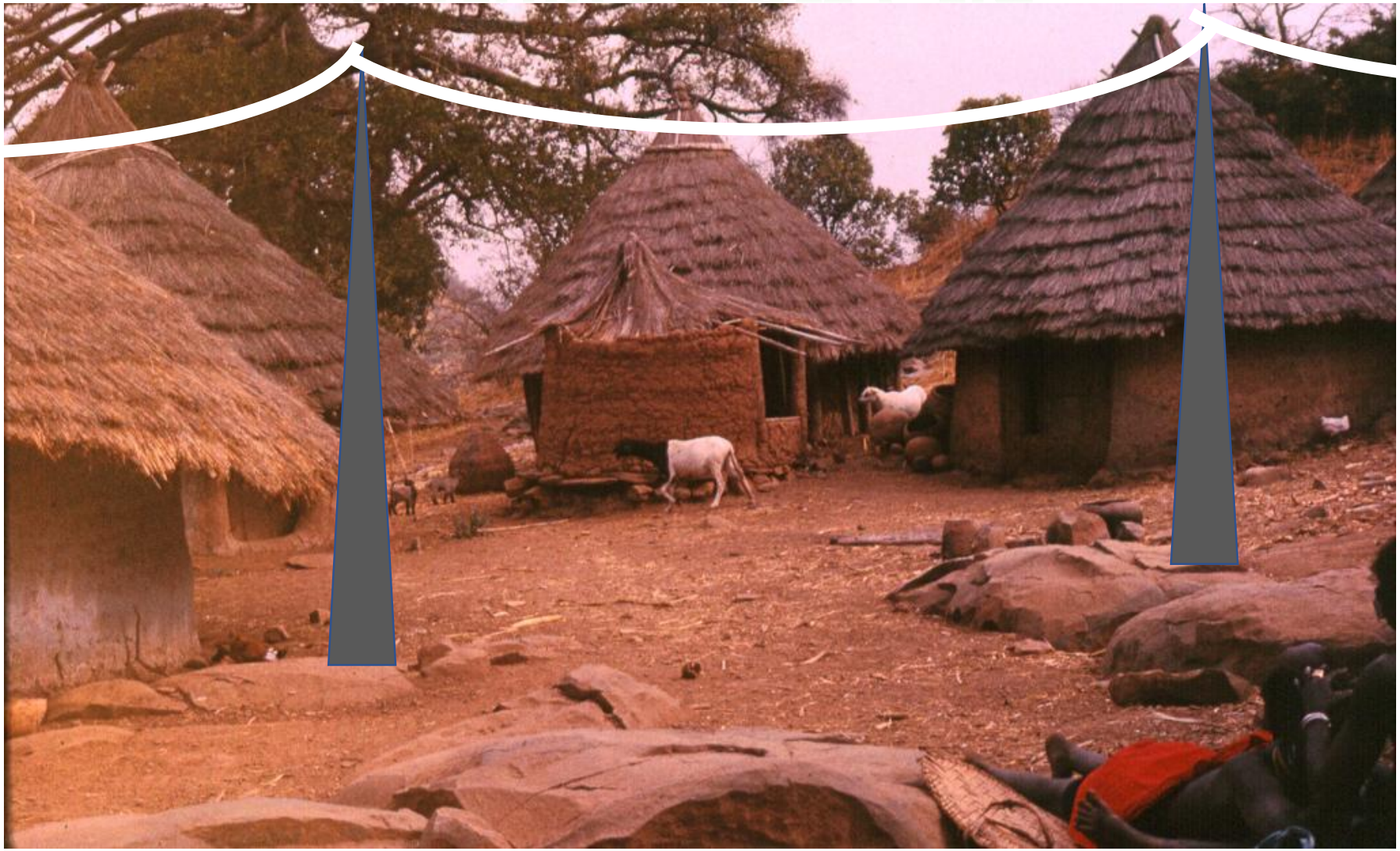
Monitoring:

1. **Consumption**
2. **Generation**
3. **Battery depth of charge**

➔ Profile building leads to more accurate distribution grid design



A Truly Smart Grid

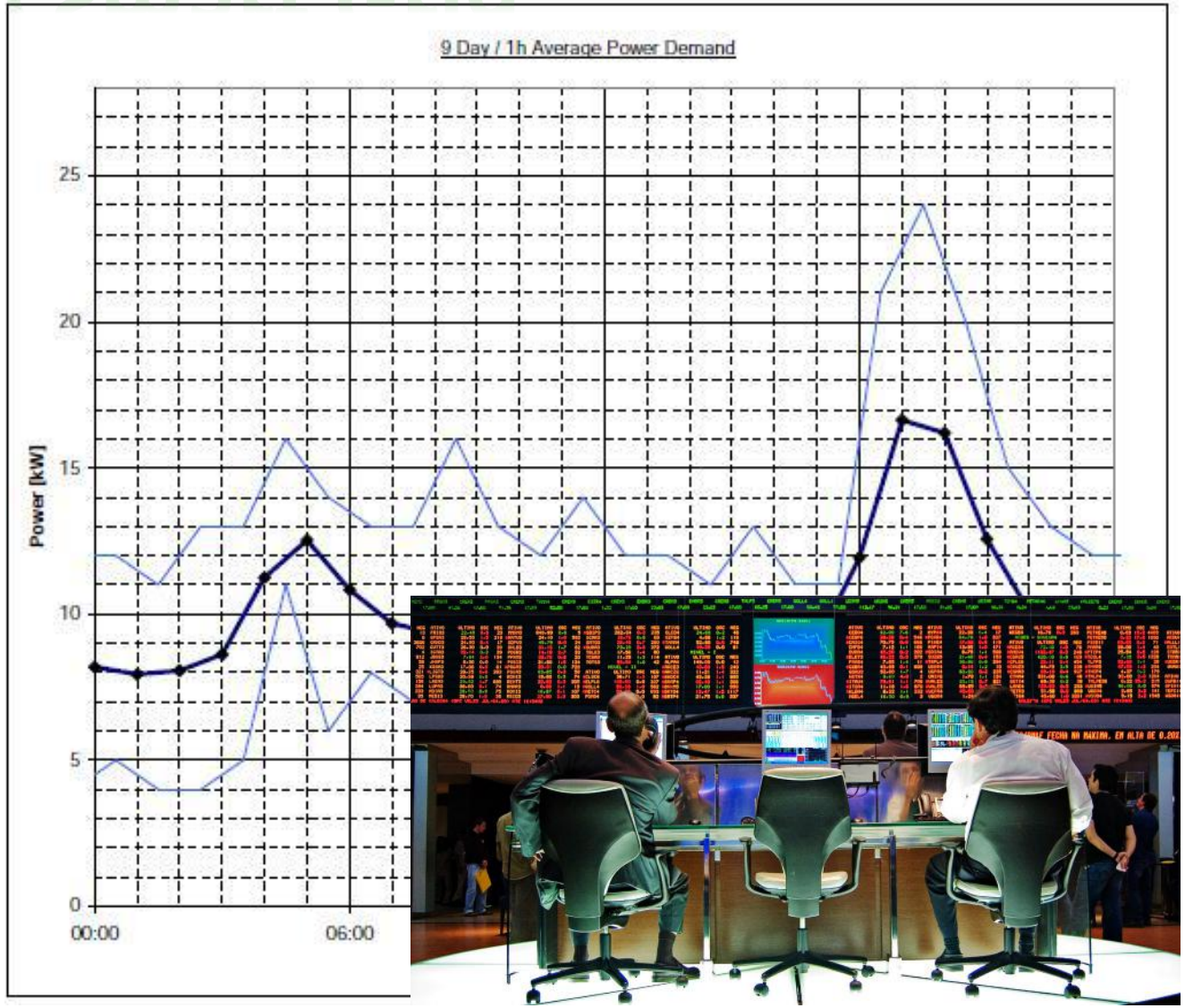


A Truly Smart Grid

- ❖ Management of battery and module size
- ❖ Growth projection for different consumer profiles
- ❖ Proper sizing of distribution grid

➔ Peer to peer energy trading – incentive to purchase oversize modules and batteries

➔ DERMS management



The Technology Transfer

Efficient and effective DERMS will be operative in Africa before Luxemburg

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