



ECEXA Photovoltaic & Energy Storage Technology

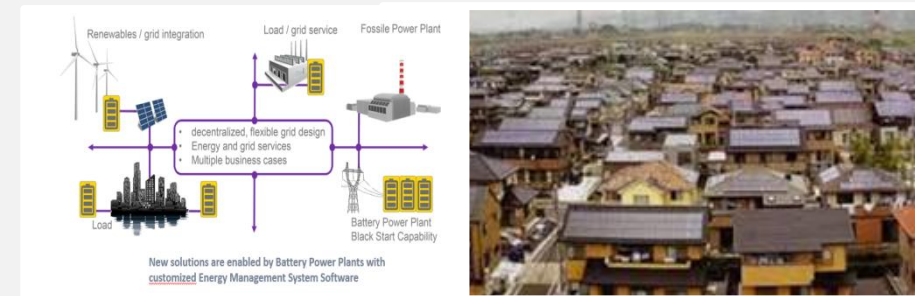
PHOTOVOLTAIC & STORAGE TECHNOLOGY

Overview

PV – Fields of Application



PV – Advantages and Options



Energy Storage Systems



Project Examples and References





PART I – Photovoltaics

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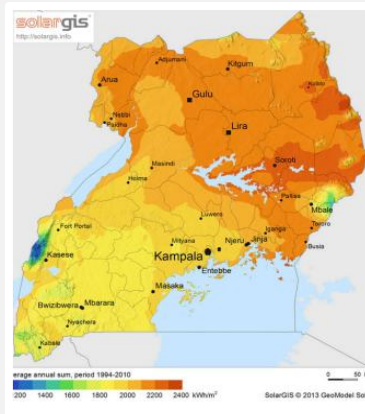
I. PV – Fields of Application & Examples

Intelligent PV solutions

- ▶ Renewable Energy Intelligent Solutions
- ▶ Offgrid/Microgrid solution
- ▶ PV as energy source
- ▶ Solar thermal+PV/household Photovoltaics & Biomass/industry
- ▶ Austrian module producer



PV Solutions from 1 MWp to 200 MWp



Intelligent Energy Solutions Examples

- ▶ Supermarket with PV
- ▶ School with Internet
- ▶ Energy Mix –Villages with >500 people

References

- ▶ Get FiT Uganda
- ▶ Solar farms
- ▶ Agriculture



Renewable Energy – Fast Solution

FAST SOLUTION

Off grid with PV or Wind mill
Hot water by solar thermal

General solution

Dezentralized systems with combinations of all Renewable Energy forms like PV, wind, water, biomass, bio gas and other storage systems



Example

SUPER MARKET WITH PV

Supermarket with Photovoltaics for **LED illumination**, **cooling** and **communication** (off grid)



School with Internet Connection

For **higher qualification**

By off grid PV solution

with **Satellite communication**



Example II – Energy Mixture

Villages with > 500 people



Solar thermal and PV for households
Photovoltaics & Biomass for industry

Biomass for the night phase

Solar thermal
Heat/cooling

Photovoltaic
Electrical



Biomass
Heat/electrical



Offgrid / Microgrid Solution

Example

Figures

- ▶ 4500 inhabitants
- ▶ Power consumption: 14 GWh/yr
- ▶ Peak power 2.3 MW

Prior power solution

- ▶ 4.6 MW DG
- ▶ 800 KW windturbine



New power generation system

- ▶ 1.0 MW PV power plant
- ▶ 5.4 MW windturbines
- ▶ 1,2 MW NaS battery @ 8.5 MWh capacity
- ▶ 1.5 MW Li-Ion battery @ 1.5 MWh capacity
- ▶ Intelligent inverter and control units
- ▶ DG standby

Renewable coverage 65%

30 % excess of energy for desalination

+ CO2-certificates

References: Solar Farms



Bithuja – India: Solar Farm 5 MWp /2011

Ronchi & Tamagnina – Italy: Solar Farm1 + 0.7 MWp /
2010

Stizkov – Czech Republic: Solar Farm 8 MWp / 2009

La Roda – Spain: Solar Farm 8 MWp / 2008

Stuttgart – Germany: Rooftop 1 MWp / 2007



References - Agriculture

Agriculture PV Greenhouse Austria



Integrated Photovoltaic system

- Plant design
- PV module design aligned to greenhouse structure
- Site and construction management
- Equipment supplier management

Greenhouse Seba, Mureck Austria



Austrian module producer

Technology Fully Automated



KIOTO SOLAR has a fully automated production line, certified after high quality EU standards



- ISO 9001
- ISO 14001
- BS OHSAS
- Extended snow load test
- Extended hail test
- Salt mist corrosion test
- DLG ammonia test
- UV long time stability test



Biggest PV power plant in Hungary with KIOTO SOLAR modules (18,5 MWp)



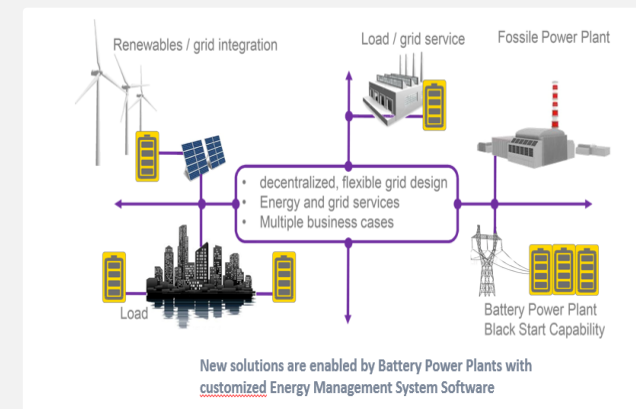
Partner of



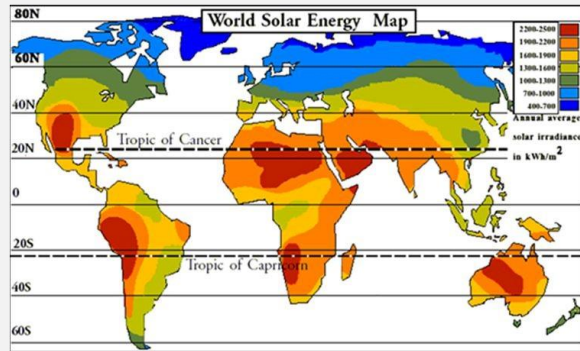
II. PV –Advantages and Options

PV Solutions from 1 MWp to 200 MWp

- ▶ Advantage of the technology for every country
- ▶ Photovoltaics as Energy source
- ▶ Requirements for a PV project
- ▶ Grid- Options through Battery Power Plant



Advantage of the technology for every country



PV module



PV cell



Produce
PV modules and panels + cells
and Solar thermal products
in every country
to secure the energy
for the future!

“Electricity decisions are political. They may be motivated by a push for climate/environmental gains, but they could also be driven by demands for social development, to create jobs, reduce costs, or to develop a manufacturing base”.

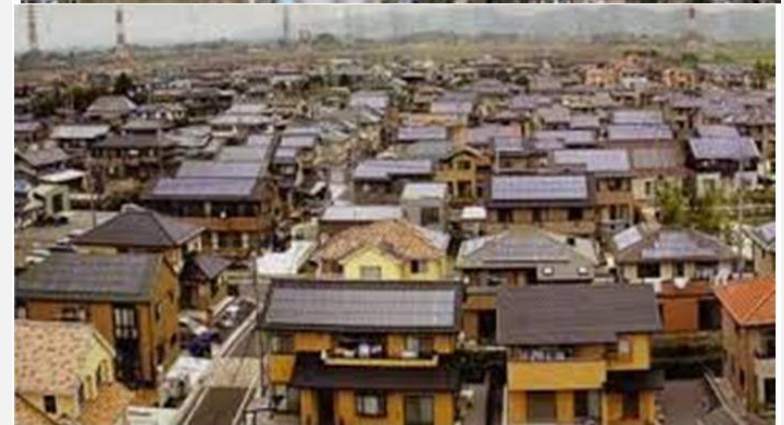
Solar thermal



Photovoltaics as Energy Source

- ▶ Wind and Photovoltaic energy will have the **biggest growing rate** in the next century
- ▶ Photovoltaic is the only technology without any maintenance in a life span of 25 year
- ▶ Photovoltaics has **grid parity** in a lot of countries
- ▶ **No carbon emission** anymore !
- ▶ Photovoltaics combined with solar thermal for heating and/or cooling are the best solution for greater buildings - **10 year life time**

Photovoltaics can be installed easily

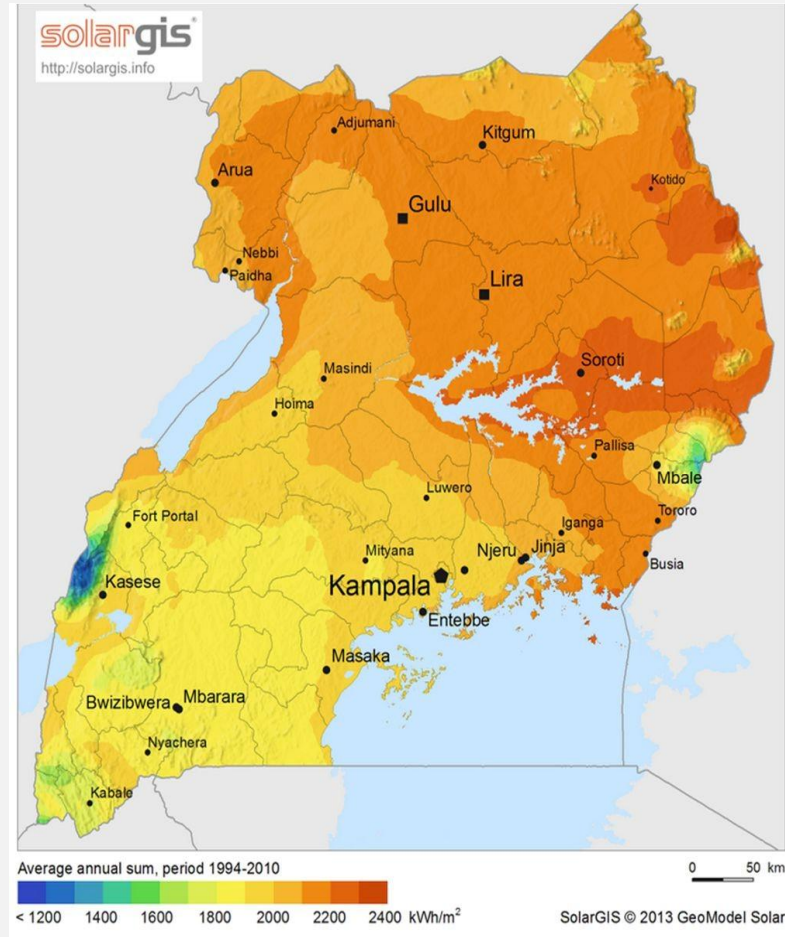


Project Requirements

- ✓ Area – Land available
- ✓ Geometrical documents of the ground
- ✓ Grid connection available
- ✓ Signed documents for grid connection
- ✓ Government documents for build a powerplant
- ✓ Transformer needed
- ✓ Power pricing

- ✓ Planning powerplant
- ✓ Financing model

EXAMPLE – GET FiT Uganda

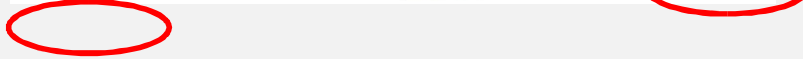
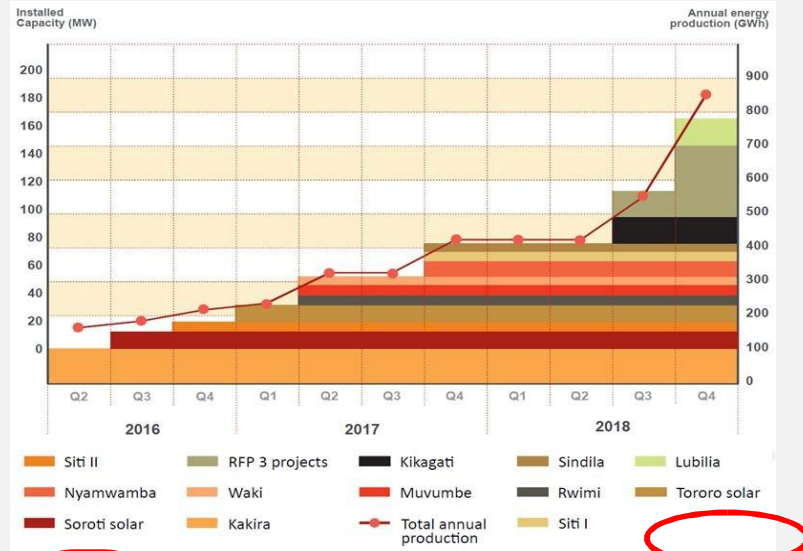


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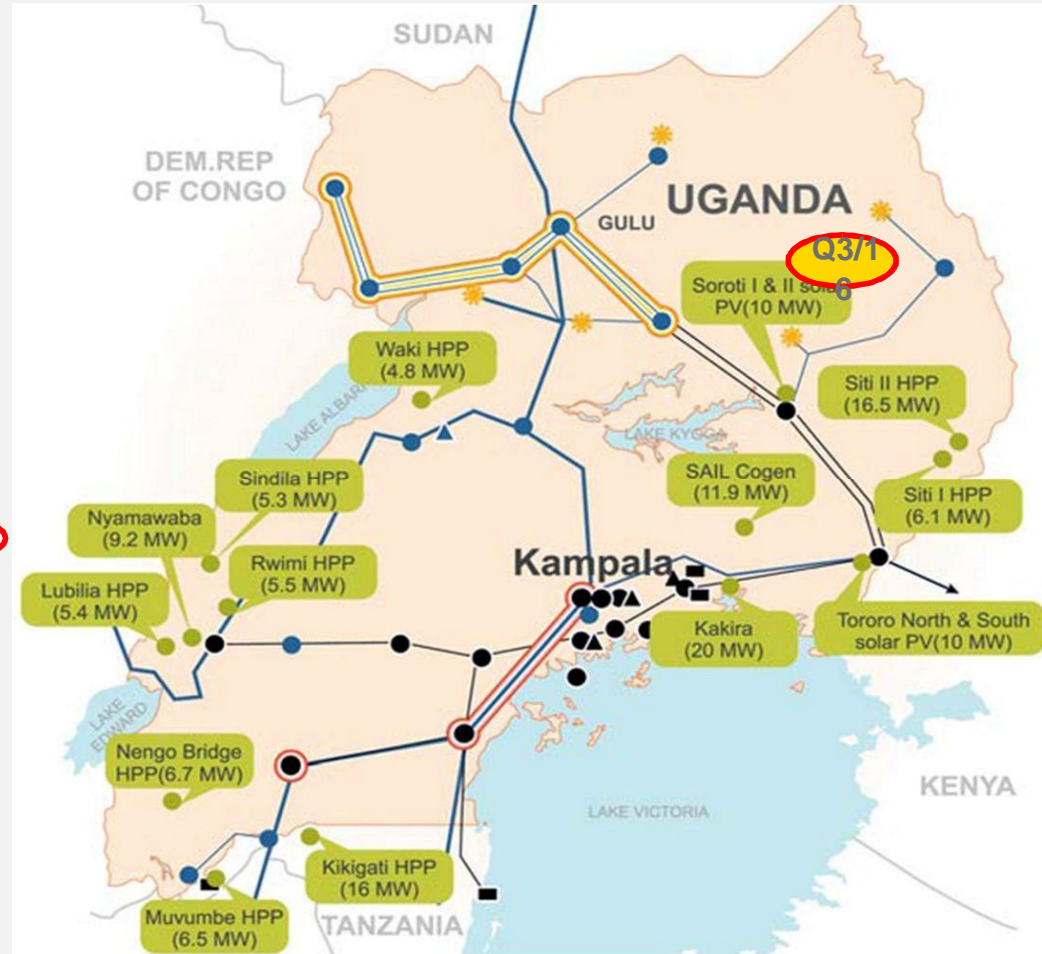
Example – GET FiT Uganda – PV Projects

PV- PROJECT EVALUATION

Annual Report 2015



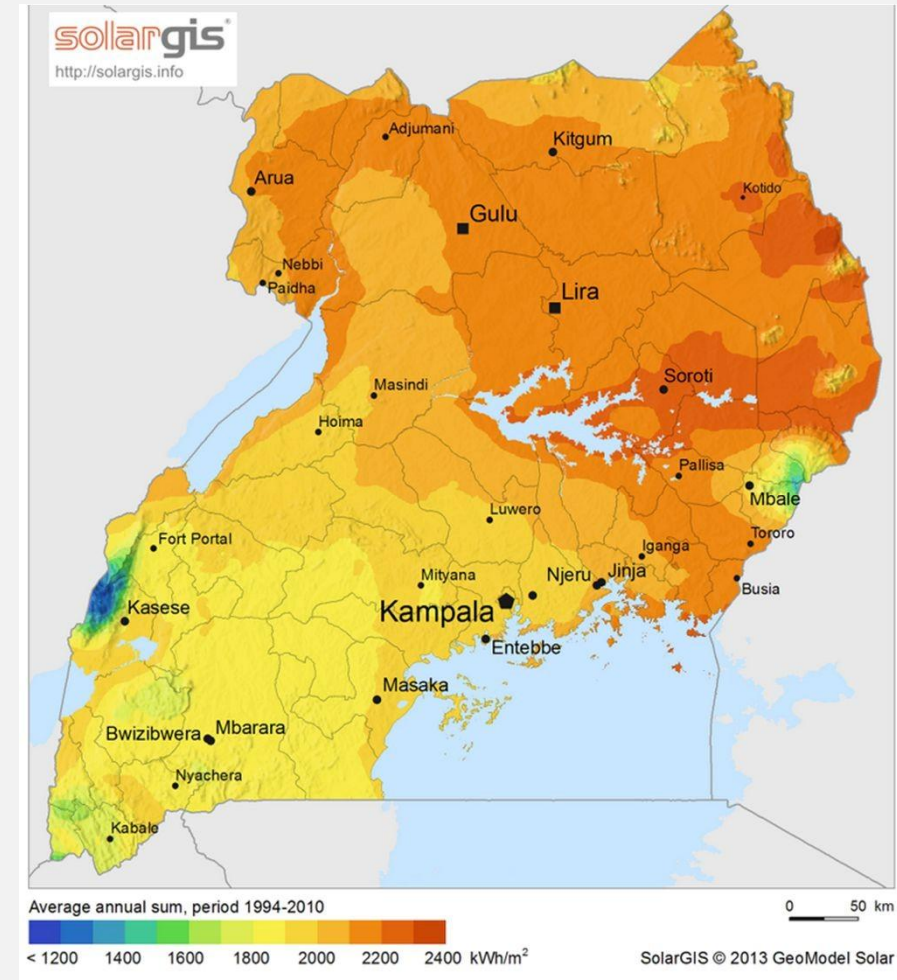
EXISTING	PROPOSED	Status 2013
—	—	132kV LINES
—	—	220kV LINES
—	—	400kV LINES
●	●	SUBSTATIONS
■	■	HYDRO GENERATING STATIONS
▲	▲	THERMAL GENERATING STATIONS
	☀	SOLAR GENERATING STATIONS



Example – GET FiT Uganda – PV Projects

Assumptions / defined by Area **PV- PROJECT EVALUATION**

Standard Tarif	0,04 €/kWh
FIT	0,103 €/kWh - 2 % p.a. 15 years
Spec. Energy	1.500 kWh/kwp
Size	10 MWp
System price	1,11 €/Wp
Bank finance	80 %
Interest	5 %
Period	15 years



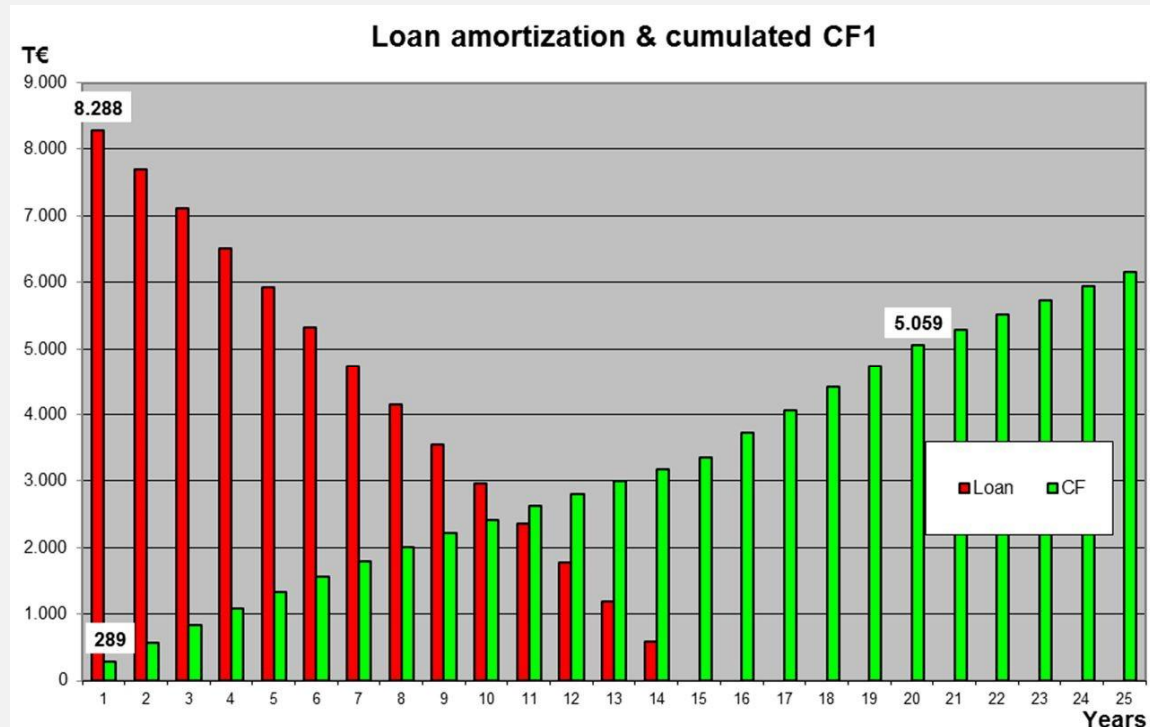
Example – GET FiT Uganda – PV Projects

PV- PROJECT EVALUATION

Field of observation: PV only

Depreciation Period y	[a]	20
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Investment Costs	[€]	100.000
Specific Investment	[EUR/kWp]	1.110
Equity Financing	[%]	20,00%
Equity Amount	[€]	220.000
Loan Financing %	[%]	80,00%
Loan Amount €	[€]	880.000
Loan Interest rate	[%/a]	5,00%
Loan Duration	[a]	15
Grace Period	[a]	0



Year 20 – cumulated CF1 = 5,06 m€

EBITDA

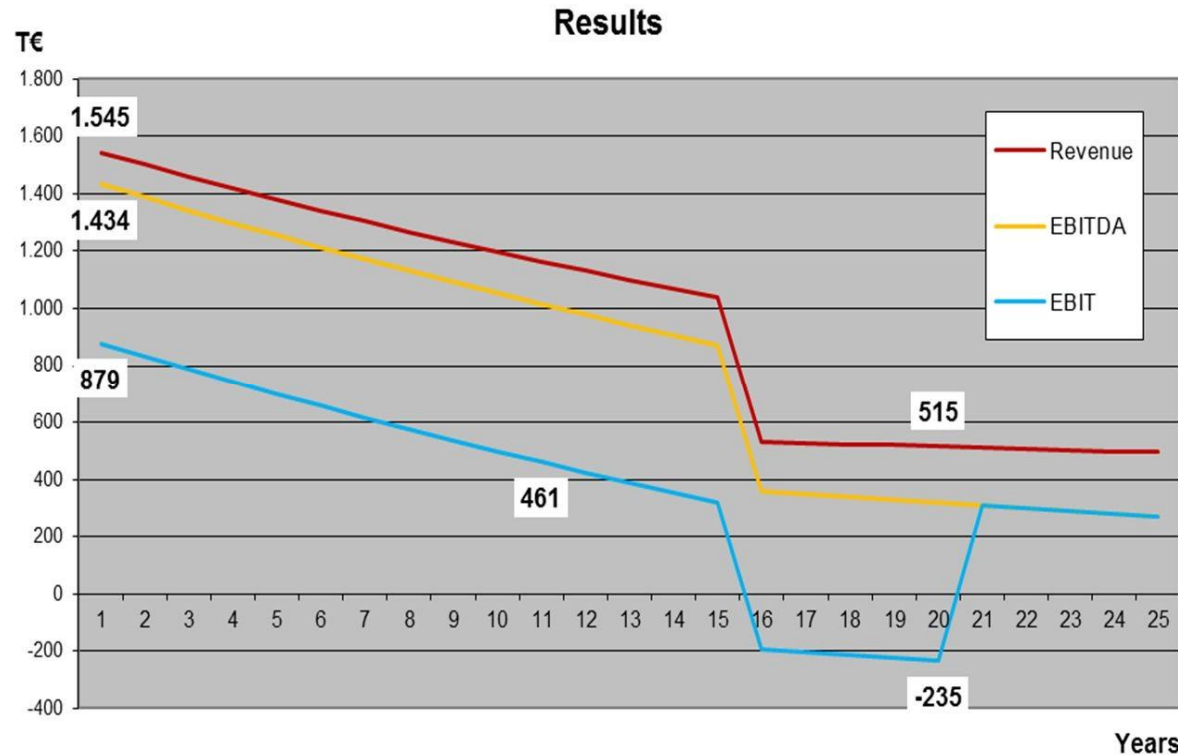
- Interest
- Tax
- Loan amortization

= CF1

Example – GET FiT Uganda – PV Projects

PV- PROJECT EVALUATION

Field of observation: PV only



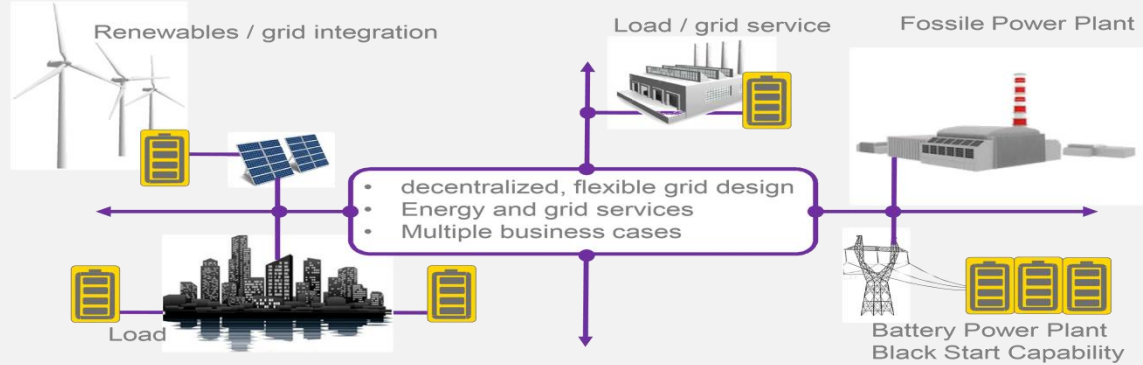
Calculation Period:	total	avg. p.a.	avg. Value pa / kWp
25 years			

Income €	24.292.165	1.214.608	121
Average EBITDA €	20.245.187	1.012.259	101
Average EBIT €	9.145.187	457.259	46
Average EBT €	5.593.187	279.659	28
Average EAT €	3.925.923	196.296	20

Average Net CF €	6.145.923	307.296	31
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IRR Equity 25 a		10,13%	
IRR Equity 20 a		9,32%	
IRR Equity 15 a		5,00%	

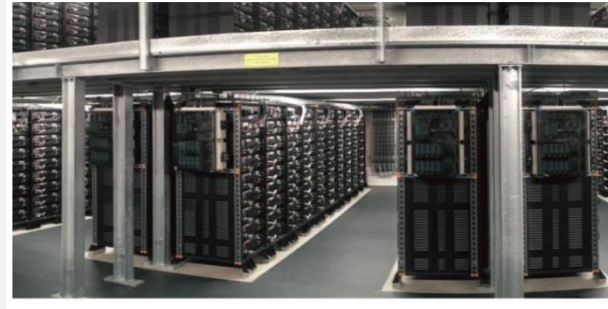
Year 15 – End of loan amortization / End of FiT
Year 20 – End of depreciation



PART II – Energy Storage Technology

PART II - ENERGY STORAGE SYSTEMS

Overview



Plug & Play Storage Systems

- ▶ Y.Cube – P&P Energy Storage Solution



Energy Storage Systems

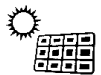
- ▶ Demand for Energy Storage Solutions
- ▶ Storage – An Application for Integrated Solutions
- ▶ Storage – Basic Application
- ▶ Design - Services for Integration and Optimization
- ▶ Battery power plant – Basic Figures
- ▶ Grid – Options through battery power plant

Demand for Energy Storage Solutions

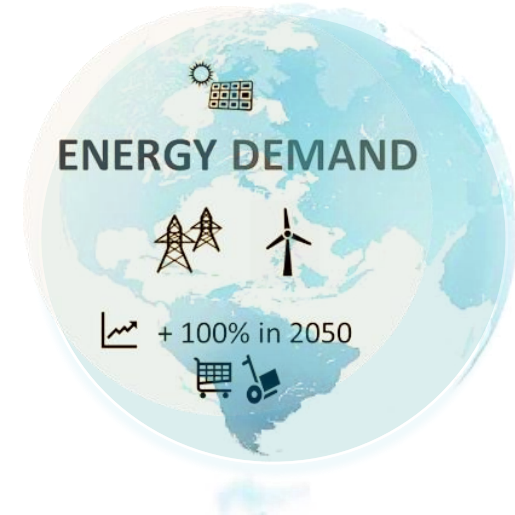


Challenges
Market

- ▶ Increasing energy demand worldwide
- ▶ Increasing renewable energy share
- ▶ Aging of conventional power plants
- ▶ Unstable grids due to renewables
- ▶ Inefficient use of renewables
- ▶ Multiples functionalities and services in parallel
- ▶ Maximize lifetime of batteries
- ▶ Optimization and automation
- ▶ Enabling hybrid systems



Challenges
Systems



Hardware
&
Software

Key factors are Energy and Plant Management Systems for grid integration

Storage - Application for Integrated Solutions

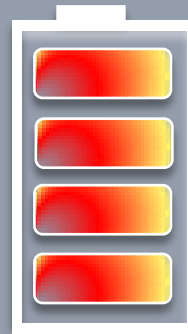
System Services

- ▶ Frequency control
- ▶ Secondary control
- ▶ Voltage control
- ▶ Black start capability
- ▶ Reactive power support
- ▶ Short circuit power
- ▶ Micro grid capability

Battery Parks

- ▶ Increased grid stability
- ▶ Avoid grid expansion costs
- ▶ Increase renewable share
- ▶ Optimize portfolios
- ▶ Reduce carbon footprint

Battery System



Grid stabilization –
Black start capability –
Off grid solution

Optimized integration
of renewables

Renewable Services

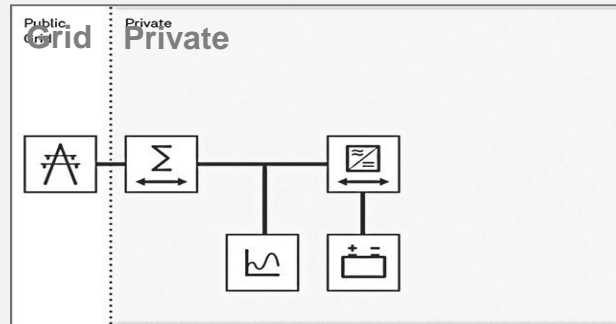
- ▶ Peak shaving
- ▶ Renewable integration
- ▶ Optimization of internal consumption
- ▶ Ramping

Island Systems

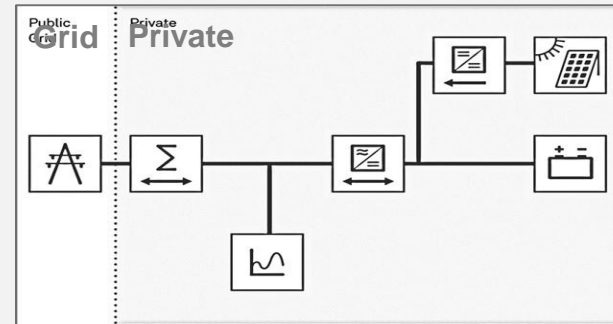
- ▶ Reduce energy cost
- ▶ Reduce dependency on diesel
- ▶ Reduce energy price volatility
- ▶ Increase renewable share
- ▶ Improve power quality

Storage – Basic Application

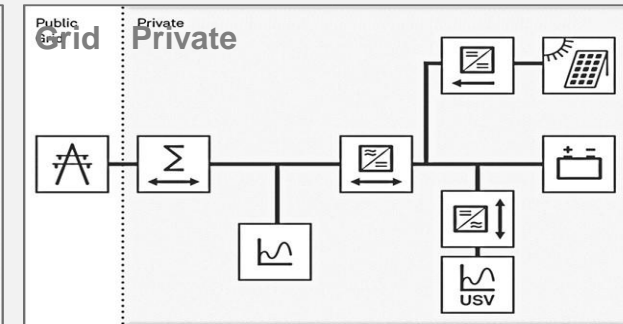
Selection of various options



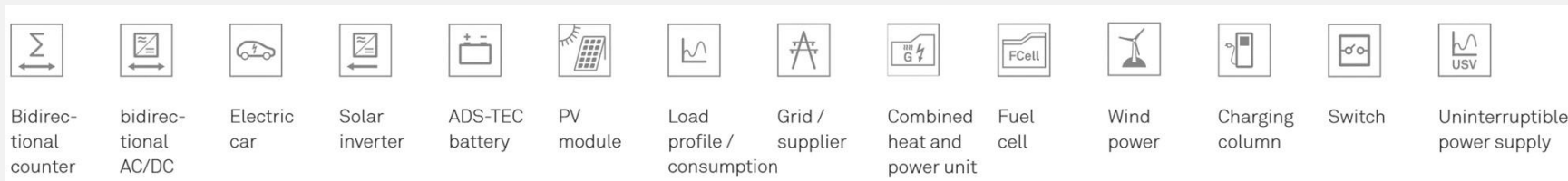
- ▶ **Storage as grid component**
- ▶ Stabilize load profile
- ▶ Peak shaving
- ▶ Limit power consumption from grid
- System service – energy reserve
- Local storage



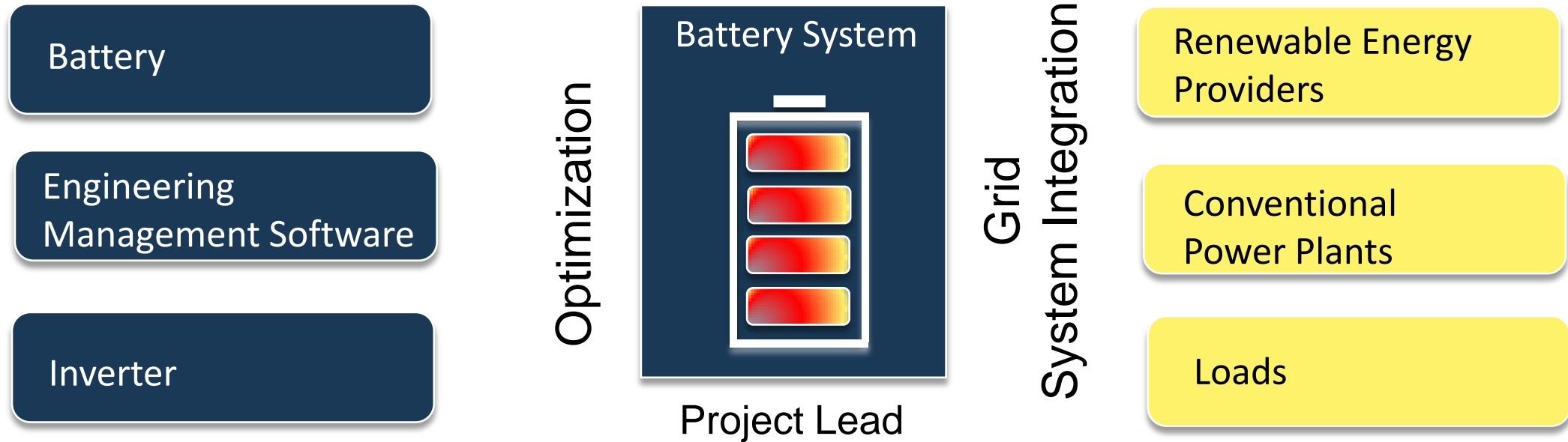
- ▶ **Storage with PV system**
- ▶ Stabilize load profile
- ▶ Peak shaving
- ▶ Limit power consumption from grid
- ▶ Limit feed-in power
- ▶ Optimize self consumption



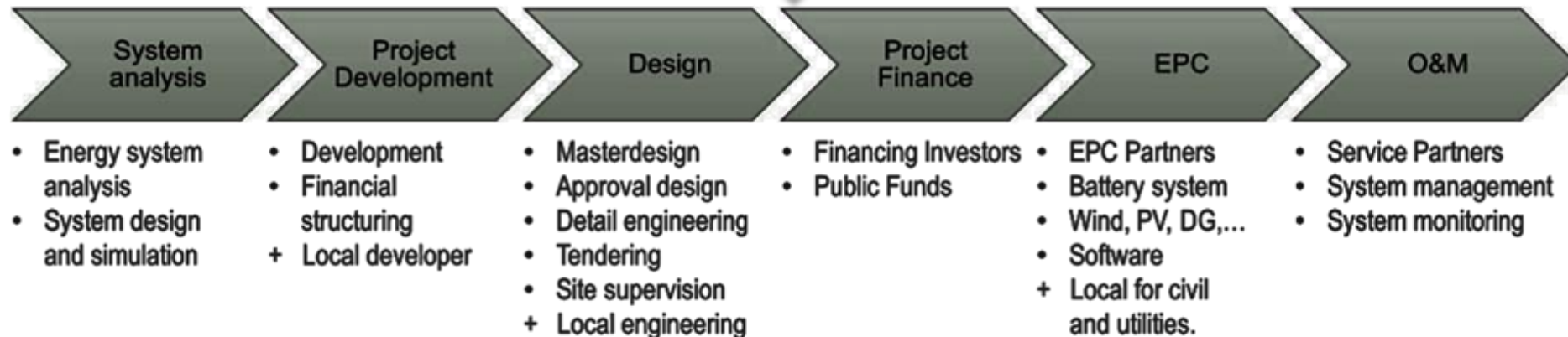
- ▶ **Storage with PV system and UPS**
- ▶ Stabilize load profile
- ▶ Peak shaving
- ▶ Limit power consumption from grid
- ▶ Limit feed-in power
- ▶ Optimize self consumption
- ▶ Online UPS



Design - Services for Integration and Optimization



Project steps



Battery Power Plant – Basic Figures

Field of observation: Storage only

Basic Figures

- ▶ Price* 780 T€/MWh
- ▶ Avg. energy cost 6-7 ct/kWh
- ▶ useful life 20 years

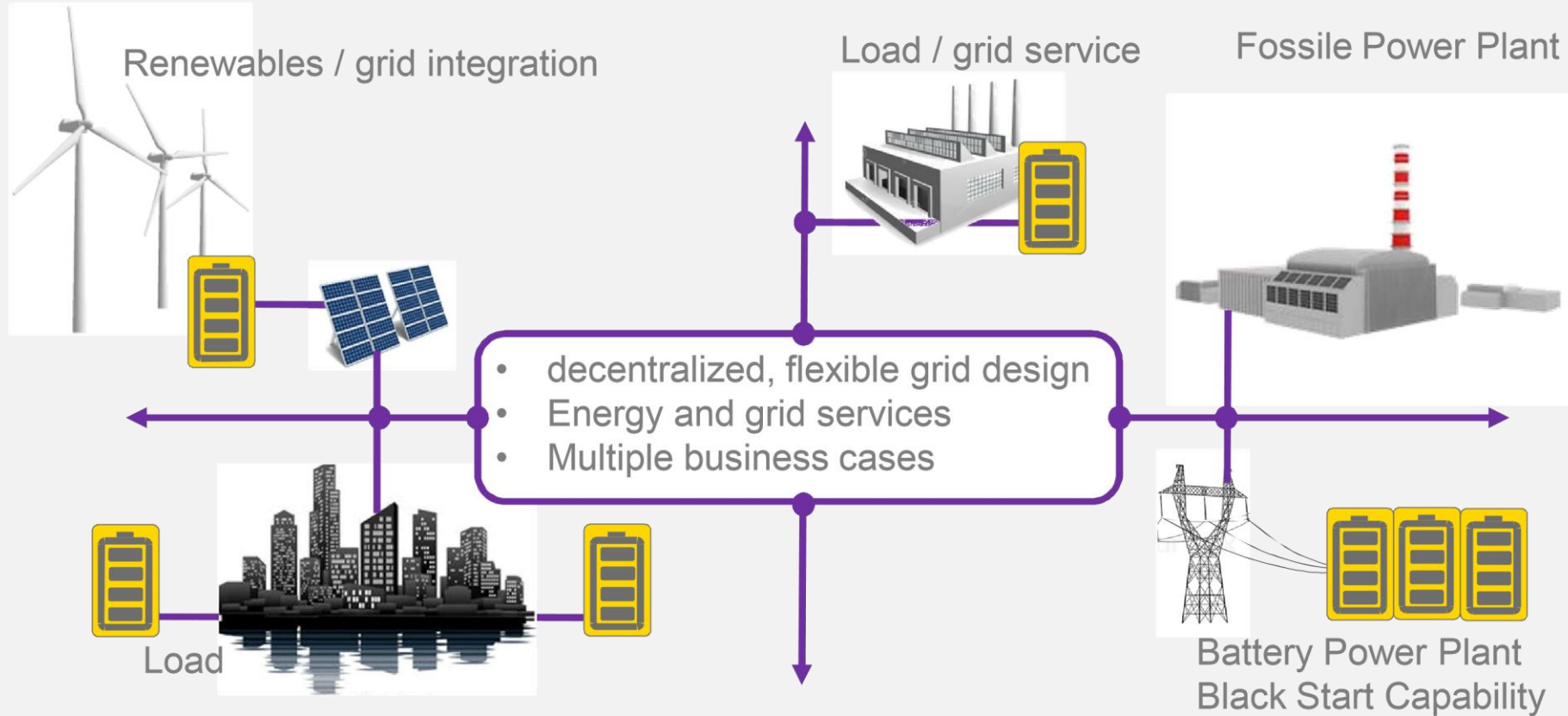
*) without infrastructure

Scope of performance

- ▶ Transformer, cabling and connection to high tension line
- ▶ Foundation, construction work
- ▶ Overall design and integration



Grid – Options through Battery Power Plants



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New solutions are enabled by Battery Power Plants with customized Energy Management System Software

Photovoltaic & Energy Storage Technology

Plug & Play Energy Storage Solutions

Y.Cube – Plug & Play Energy Storage

Technical Features

Type	Capacity kWh	Full Load 100 %		Part Load 50 %		Part Load 25 %	
		Duration h	Power kW	Duration h	Power kW	Duration h	Power kW
250-222	222	0,8	250	1,6	125	3,2	63
250-555	555	2,0	250	3,9	125	7,9	63
250-887	887	3,2	250	6,2	125	12,6	63
500-555	555	1,0	500	2,0	250	3,9	125
500-887	887	1,6	500	3,2	250	6,3	125



PART III - About ECEXA

We think ENERGY differently!

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We are partner for all issues of energy

- ▶ Our goals:
To provide advise starting from first analysis to the implementation
- ▶ Systemic part:
To help you to save energy that is needed elsewhere
- ▶ To use energy to maximise its impact
- ▶ Key elements: efficiency, effectivitiy and quality
- ▶ Our focus is to transfer high quality environmental technology to development and transition countries



Your benefit: A comprehensive solution carried out by one partner

About ECEXA

- ▶ ECEXA is an Austrian Environmental Cluster with office in Baden/Vienna.
- ▶ Our highly qualified core team and an international team of leading experts consults investors and project owners with comprehensive corporate strategies
- ▶ We act as bridge builder between national governments, provinces, communities and companies of energy and environmental industries



We are partner for all issues
of **Renewable energy supply,**
Remediation, Improving
Sanitation, Water &
Wastewater technology, and
Resources.



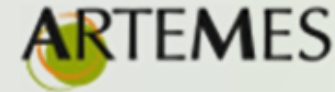
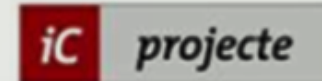
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concepts

- ▶ Our expertise lies in the experience as a problem solver.
- ▶ We help communities and businesses to do everything themselves. Finance, build and operate equipment, commission and operate, and training of waste and environmental professionals.
- ▶ We contribute to create a sustainable economy, society, and environment.

Together we create a „win-win“ situation for both operators and environment



Our partners provide the optimal sustainable energy solution





Photovoltaic & Energy Storage Technology

Offgrid/Microgrid PV & Storage Wind-Water-Biomass-Biogas Battery Power Plant
 Y.Cube – Plug and Play Energy Storage