



blueplanet gridsave 50.0 TL3-S

Open, bidirectional battery inverter technology



Large Scale ESS Market Overview Europe

Dr. Martin Ammon | EuPD Research | April 4, 2018

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Corporate Health
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Deutsches CleanTech Institut

- CleanTechnologies, Energy Markets
- Policy and business consulting

Business Cases

Assessment of business cases in European countries

Business case		short term	mid term	long term
Behind the meter	Optimization of Self-Consumption	++	+++	++
	Peak Shaving	+	+	0
	Demand Response	+	+++	0
	Backup Power	-	+	+
	Time-of-use Bill Reduction	+	++	+++
	Limitation of Grid Feed-in	-	+	++
	Optimization of electricity supply	+	++	+++
	Energy generation	+	+++	+++
Front of the meter	Supply of reserve power	++	+++	+
	Frequency regulation	++	+++	+
	Limitation of Grid Connection	+	+++	++
	Black start	-	+	+
	Energy Arbitrage	depending on regulation		
	Micro grid (island)	+	+++	++
	Locally shared storage systems	-	+	+++

best [+++] worse [-] no assessment [0]



Market Overview – Germany

Most important projects (since 2015) (I/II)

- Since 2015 around 30 storage systems over 1 MW net capacity with an cumulated capacity of over 400 MWh were installed in Germany.

Segmentation	Status	Project title	Operator	Net Capacity	Power	Installation	Technology	Location
grid stabilization	operational	Regionale Regelkraftwerk Feldheim (RRKW)	Enercon	10,8 MWh	10,0 MW	2015	Lithium Ion	Feldheim
reserve power	operational	BESS Neuhardenberg	Upside Group	5,0 MWh	5,0 MW	2015	Lithium Ion	Neuhardenberg
reserve power	operational	Project 2nd life	Vattenfall/ Bosch/ BMW	2,8 MWh	2,0 MW	2016	Lithium Ion	Hamburg
grid stabilization	operational	M5BAT	Aachen University of Technology (RWTH)	5,0 MWh	5,0 MW	2016	5 different battery technologies	Aachen
reserve power	operational		Steag	120,0 MWh	90,0 MW	2016/ 2017	Lithium Ion	6 sites
grid stabilization	operational	Daimler 2nd Life Storage	Daimler AG	13,0 MWh	5,0 MW	2016	Lithium Ion	Lünen
energy generation	operational	RedoxWind	Fraunhofer ICT	20,0 MWh	2,0 MW	2017	Redox Flow	Pfinztal
grid stabilization	operational		SWB	15,0 MWh	20,0 MW	2017	Hybrid (Lithium-Ion & Power-to-Heat)	Bremen



Market Overview – Germany

Most important projects (since 2015) (II/II)

- Until today several large scale ESS projects have been announced to be completed in 2018.

Segmentation	Status	Project title	Operator	Net Capacity	Power	Installation	Technology	Location
grid stabilization/ reserve power	operational		Utility "Eins Energie"	16,0 MWh	10,0 MW	2017	Lithium Ion	Chemnitz
reserve power	operational		Coulomb	18,0 MWh	17,0 MW	2017	Lithium Ion	Elverlingsen
reserve power	announced		ENERTRAG	33,0 MWh	22,0 MW	2018	Lithium Ion	Cremzow
grid stabilization	under construction	EnspireME	Eneco/Mitsubishi	50,0 MWh	48,0 MW	2018	Lithium Ion	Jardelund
reserve power/ peak shaving	under construction			4,0 MWh	8,5 MW	2018	Lithium Ion	Vöhringen
energy generation	under construction		Utility	8,0 MWh	16,0 MW	2018	Lithium Ion	Kempton
grid stabilization	under construction		VBB	15,0 MWh	10,0 MW	2018	Lithium Ion	Bordesholm
peak shaving	under construction		Baywa r.e.	0,3 MWh	0,1 MW	2018	Lithium Ion	Berlin
reserve power	announced		LUNA Group		40 - 60 MW	2018	Lithium Ion	2 sites



Market Overview – United Kingdom

Most important projects (since 2015) (I/II)

- Based on first EFR tender in 2016 we see a strong growth in ESS installations in the UK

Segmentation	Status	Project title	Operator	Net Capacity	Power	Installation	Technology	Location
reserve power	operational	AES Kilroot Advancion Energy Storage Array	AES	5,0 MWh	10,0 MW	2015	Lithium Ion	Carrickfergus
energy generation	operational	EPSRC Grid Connected	ABB	1,0 MWh	2,0 MW	2016	Lithium Ion	Willenhall
reserve power	operational	Low Carbon Battery Park	Low Carbon	28,0 MWh	40,0 MW	2016	Lithium Ion	Glassenbury
reserve power	operational	Low Carbon Battery Park	Low Carbon	7,0 MWh	10,0 MW	2016	Lithium Ion	Cleator
reserve power	operational	Clayhill solar farm		3,3 MWh	6,0 MW	2017	Lithium Ion	Flitwick
grid stabilization	operational	Blackburn Meadows EFR battery	E.ON	7,2 MWh	10,0 MW	2017	Lithium Ion	Sheffield
grid stabilization	operational		Foresight Group	3,3 MWh	10,0 MW	2017	Lithium Ion	Nevendon
grid stabilization	operational	Noriker Power Staunch project	Hazel Capital	10,0 MWh	20,0 MW	2017	4 MW Lithium Ion/ 16 MW VRLA	Bristol



Market Overview – United Kingdom

Most important projects (since 2015) (II/II)

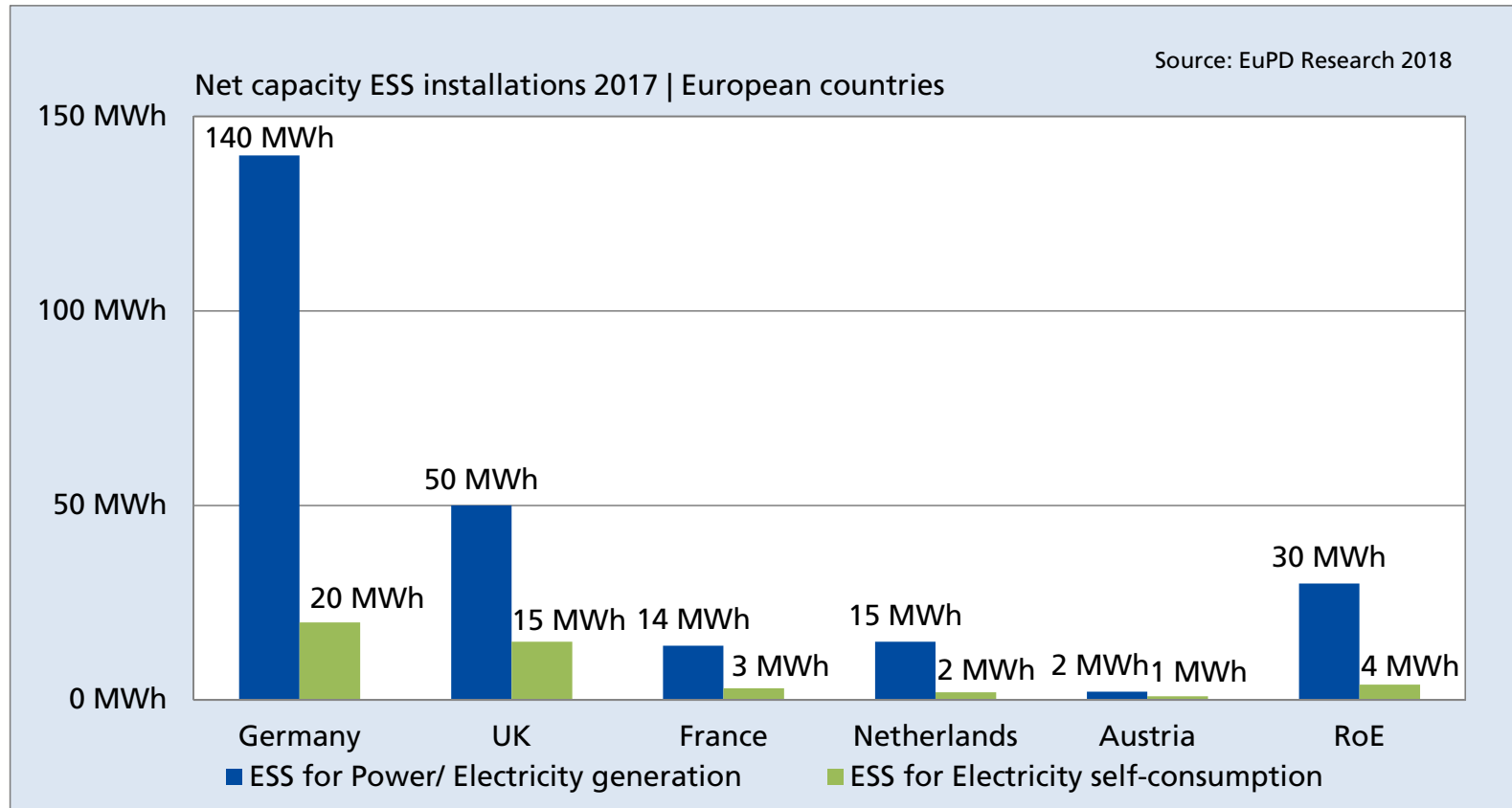
Segmentation	Status	Project title	Operator	Net Capacity	Power	Installation	Technology	Location
energy generation	operational	Northern Powergrid CLNR EES1, Rise Carr		5,0 MWh	2,0 MW	2017	Lithium Ion	Rise Carr
grid stabilization	under construction	Bank Offshore Wind Farm	Dong Energy	4,4 MWh	2,0 MW	2017	Lithium Ion	Liverpool Bay
grid stabilization	operational		RES Group	16,0 MWh	20,0 MW	2017	Lithium Ion	Broxburn
energy generation	under construction		Arenko		41,0 MW	2018	Lithium Ion	Midlands
grid stabilization	under construction		RES Group	23,0 MWh	35,0 MW	2018	Lithium Ion	Port of Tyne
grid stabilization	operational		NEC Energy	80,0 MWh	40,0 MW	2018	Lithium Ion	Kent
grid stabilization	operational		NEC Energy	20,0 MWh	10,0 MW	2018	Lithium Ion	Cumbria
grid stabilization	under construction		Centrica	24,5 MWh	49,0 MW	2018	Lithium Ion	Cumbria
grid stabilization	announced		EDF Energy Renewables Limited UK	25,0 MWh	49,0 MW	2018	Lithium Ion	not specified
grid stabilization	announced		Vattenfall	29,0 MWh	22,0 MW	2018	Lithium Ion	Pen y Cymoedd wind farm
grid stabilization	operational		KiWi Power	4,8 MWh	4,0 MW	2018	Lithium Ion	South Wales



Market Volume

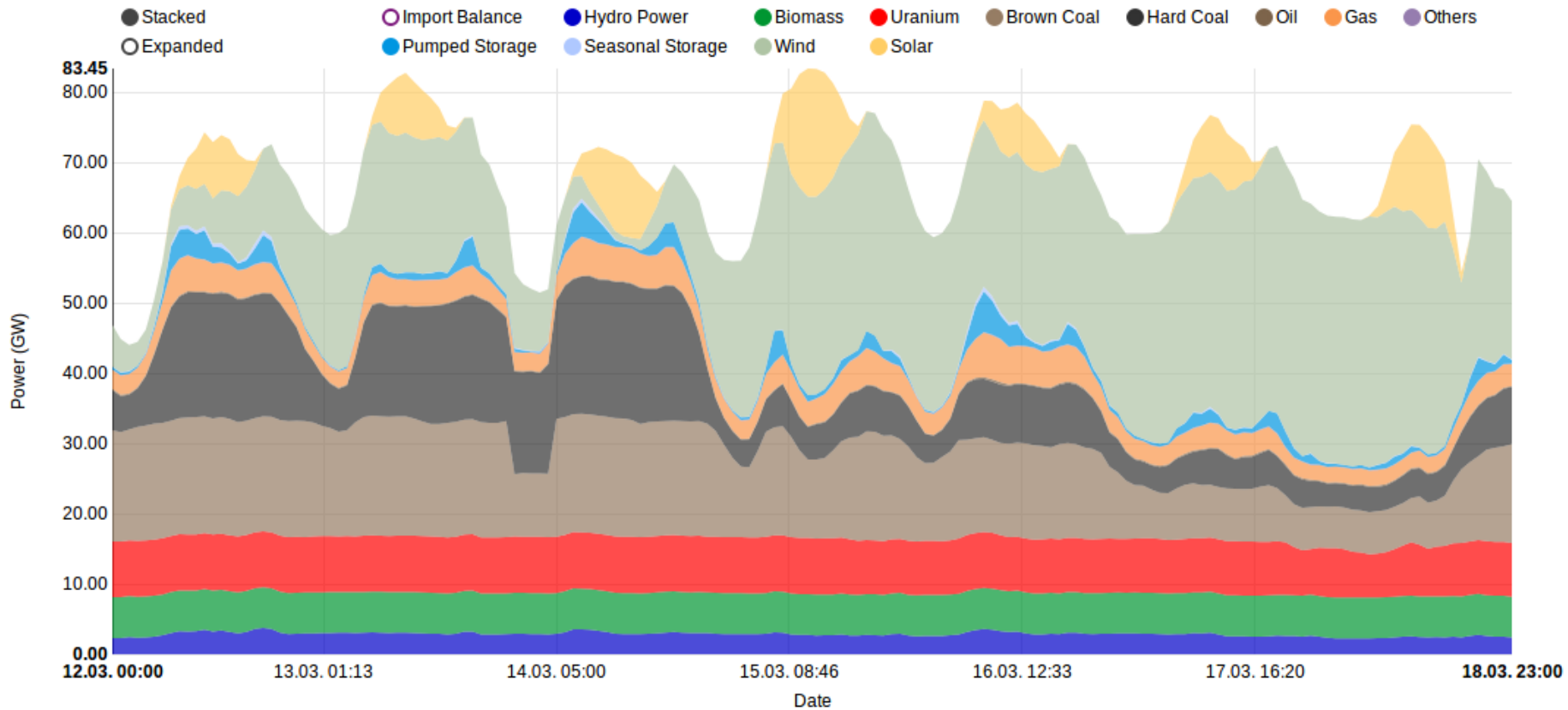
ESS Installations 2017

- All over Europe we estimate new large scale ESS installations for power/electricity generation of around 250 MWh net capacity in 2017.



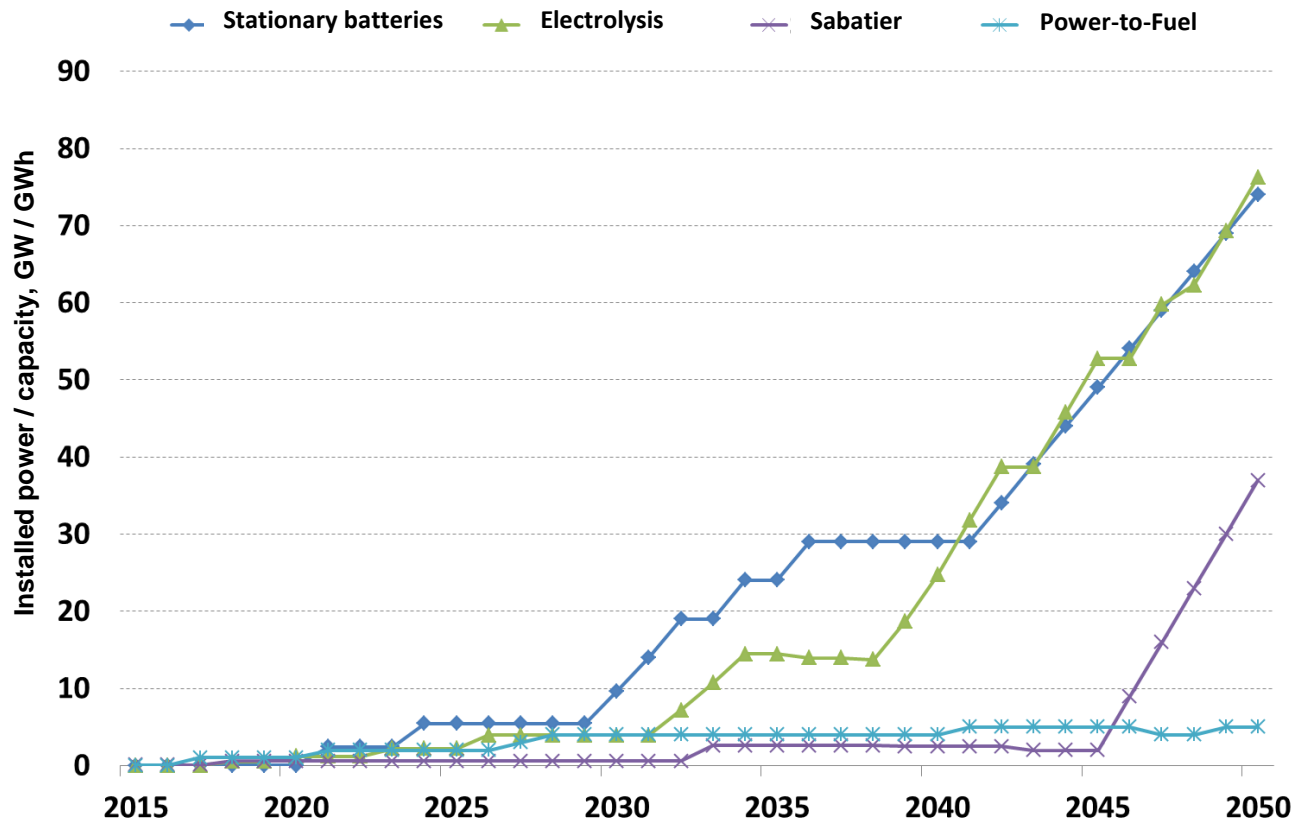
Electricity Generation, Week 11 2018

Fraunhofer ISE Energy Charts



Stationary Batteries and Synthetic Energy Carriers

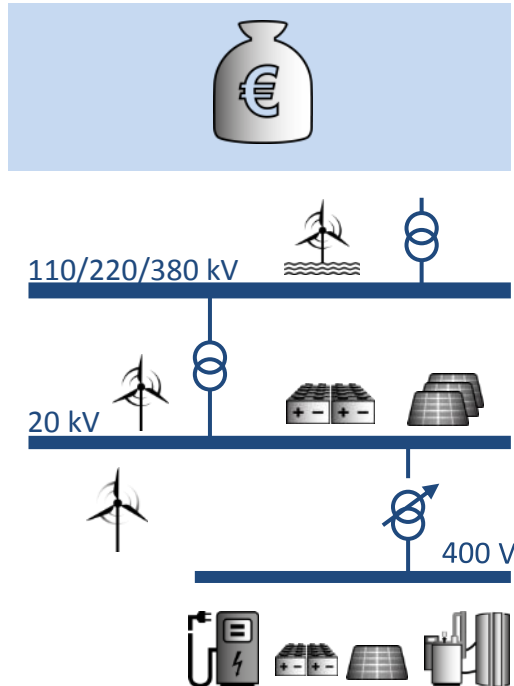
– 85% Scenario



Source: H.-M. Henning, A. Palzer, Studie "WAS KOSTET DIE ENERGIEWENDE? - Wege zur Transformation des deutschen Energiesystems bis 2050", Fraunhofer ISE, Nov. 2015

PV Battery Systems

Range of Applications

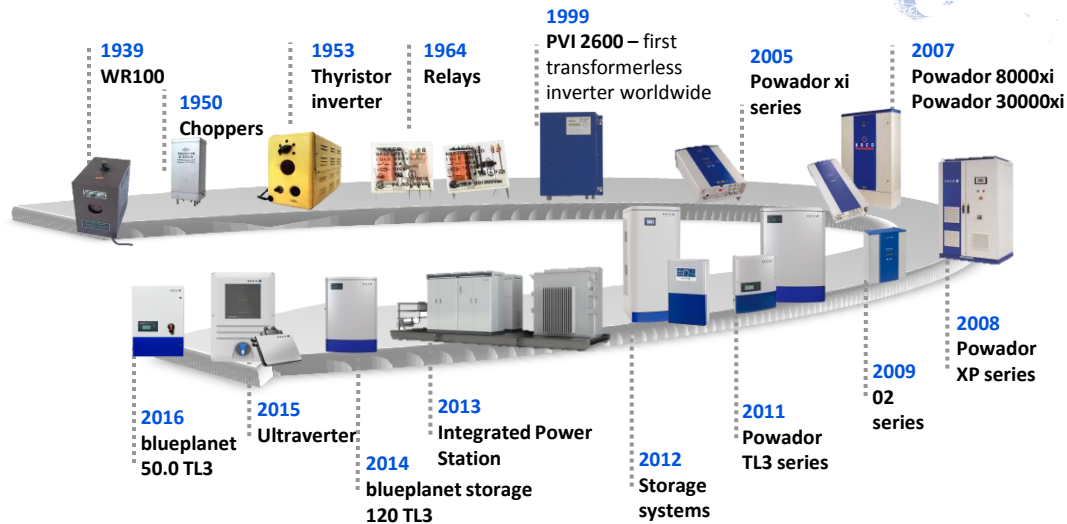


- Market participation, if necessary via pools
 - Balancing energy
 - Spot market
- Supply of system services
 - Frequency regulation
 - Reactive power
- Grid-friendly control
- Backup function, Stabilisation at the connection point
- Optimization of local self-consumption



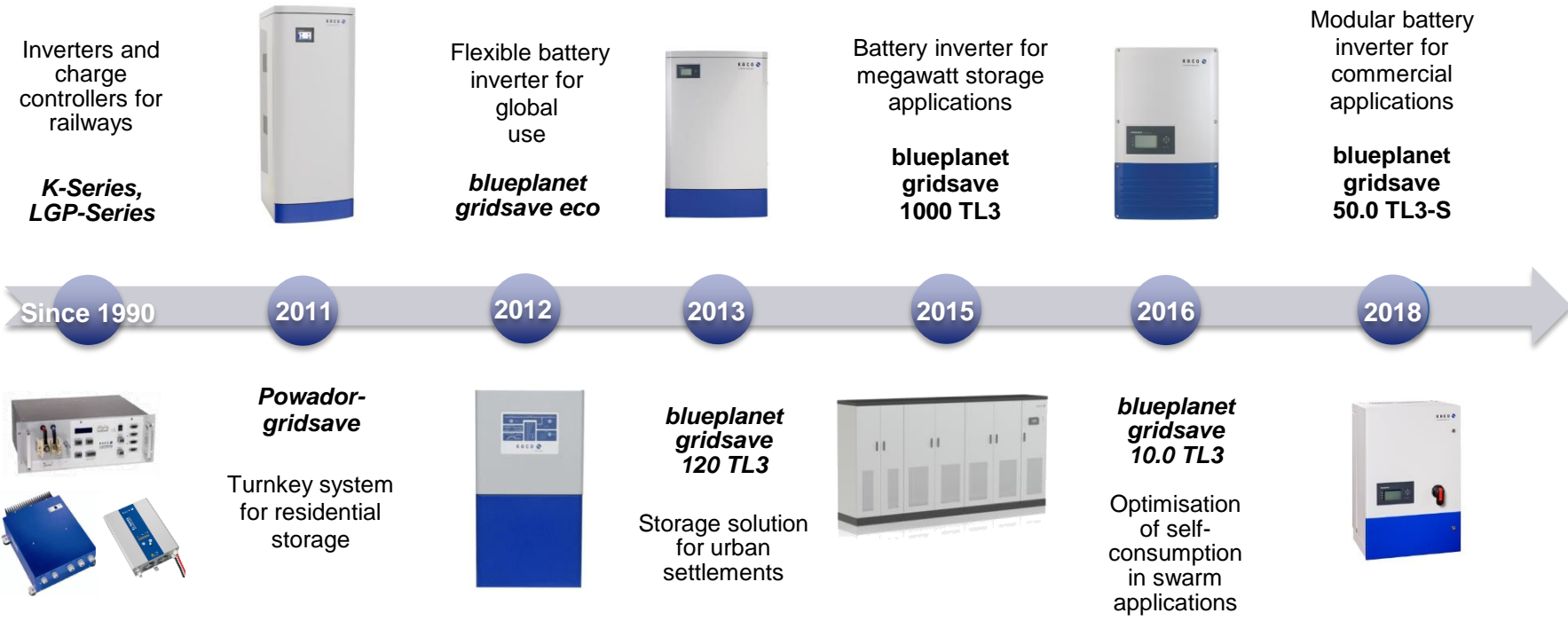
Consideration between the different applications?

About KACO new energy



12 GW cumulative inverter power shipped worldwide

Early Adopter of Energy Storage Technology



Integrated Storage Solution for Large Consumers

Energy self-sufficient residential estate in Weinsberg, Germany



Innovative battery storage concept by KACO new energy successfully in use since 2014.

Bidirectional Battery Inverter Technology

23 households, 1 electrical and several thermal storage systems in an energy network

- 120 kW battery inverter
- 145 kW PV generation
- 27 kW CHP plant

- 150 kWh Li-ion – HV battery
- Thermal storage 20.000 ltr

- Grid management via EMS
EMS – Energy Management System

- High self-sufficiency
up to 89% per annum
min. 70% in winter ...max. 97% in summer

- Prizes
a) Smart Grids-Quartier-Award
b) SEMICRON Innovationspreis 2013



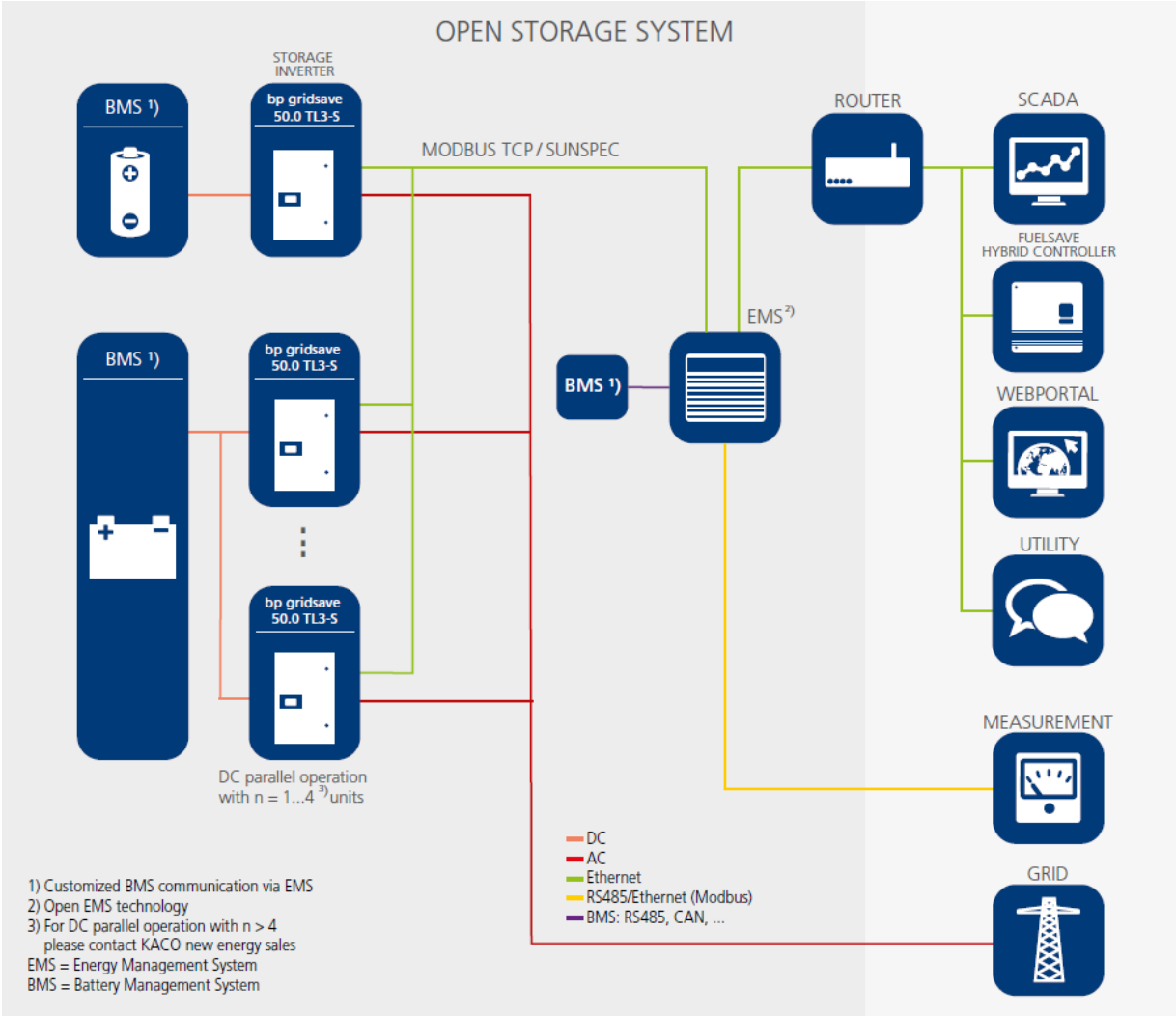
Frequency Regulation

For KEPCO (Korean Electric Power Corporation), Yongin (Seoul)



- Battery capacity: 4.0 MWh (Samsung SDI Li-ion)
- Battery inverter: 8x blueplanet gridsave 1000 TL3
- Commissioned: 2016

Open Battery Storage System



Technical Data

blueplanet gridsave 50.0 TL3-S

DC

Max. input current	90 A
Max. short circuit current	150 A
Operating range	580 V - 910 V
Number of DC inputs	1

AC

Rated output (@230V)	50 kVA
Line voltage	400 V / 230 V
Rated current	3 x 72.4 A @230V
Frequency	50 / 60 Hz
THD	≤1 %

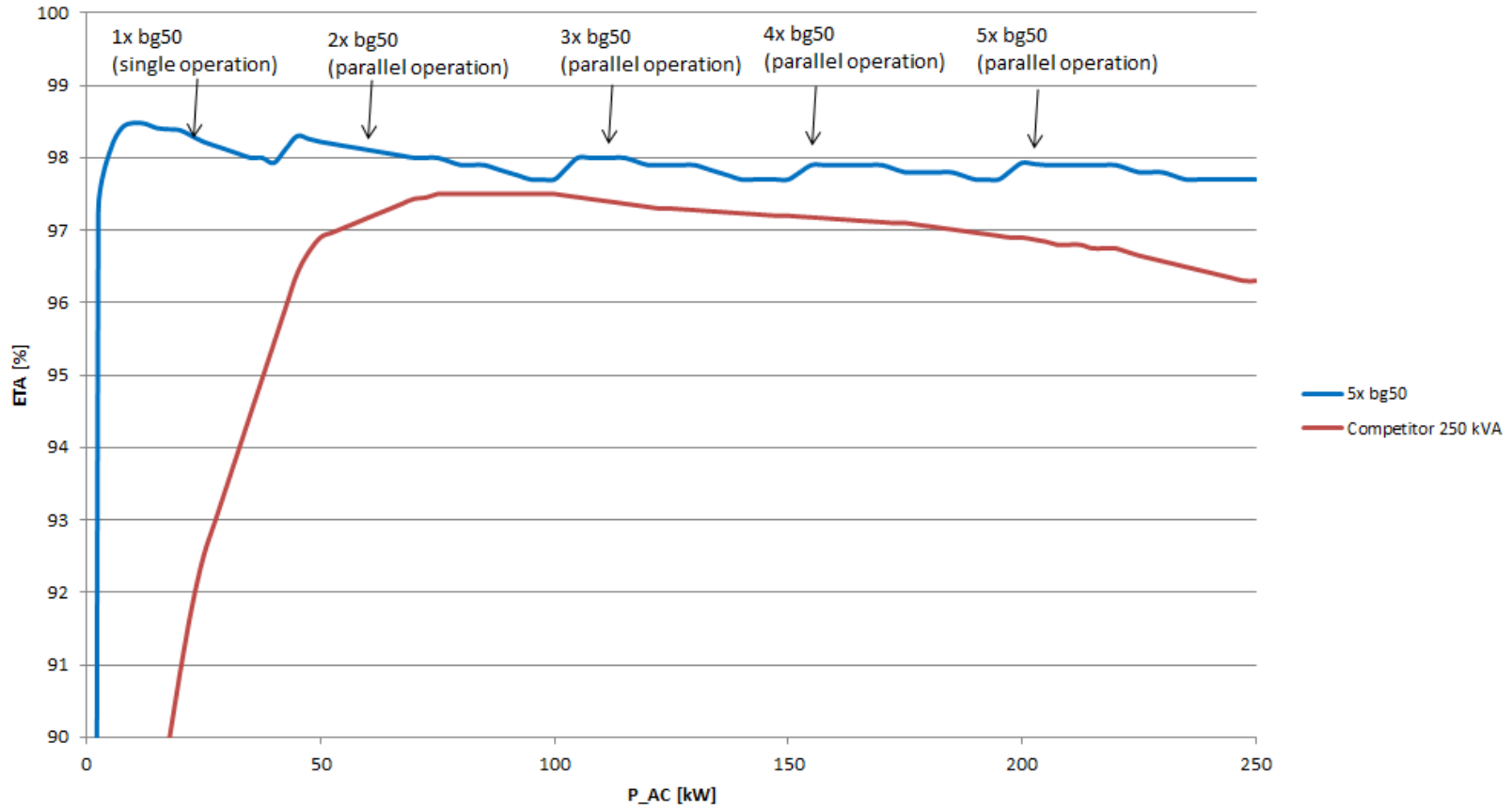
General Data

Max. efficiency	98,50%
Interfaces	2 x Ethernet, USB
Communication	TCP/IP, Modbus TCP
Operation mode	On-grid (charge / discharge)
Batteries	All battery types, e.g. Lithium-ion
Standby consumption, w/ Pre-Charge Unit	P ≤ 3 W
Standby consumption, w/o Pre-Charge Unit	P ≤ 5 W



Exemplary Efficiency Curve

blueplanet gridsave 50.0 TL3-S (BG50) vs. centralised battery inverter



Highlights

blueplanet gridsave 50.0 TL3-S

- 50 kVA rated power
- AC coupled
- DC parallel operation
- Compatible with various battery types, e.g. Lithium-ion
- Reactive power capable
- Scalable system
- Open Sunspec Modbus TCP communication for use with different EMS's
- Compact and lightweight for wall-mounting



Advantages of DC Parallel Connection

The blueplanet gridsave 50.0 TL3-S can be connected to one battery in parallel on the DC side (up 15 inverters).

System Cost



- Reduced hardware costs: only one BMS needed instead of several
- Simplified system design: Monitoring by EMS required for only one BMS for SOC of battery

Flexibility



- Flexible system design layout: Battery and system scalable
- Flexible operation: In times of low power, system runs on reduced number of inverters that can be operated at higher power output

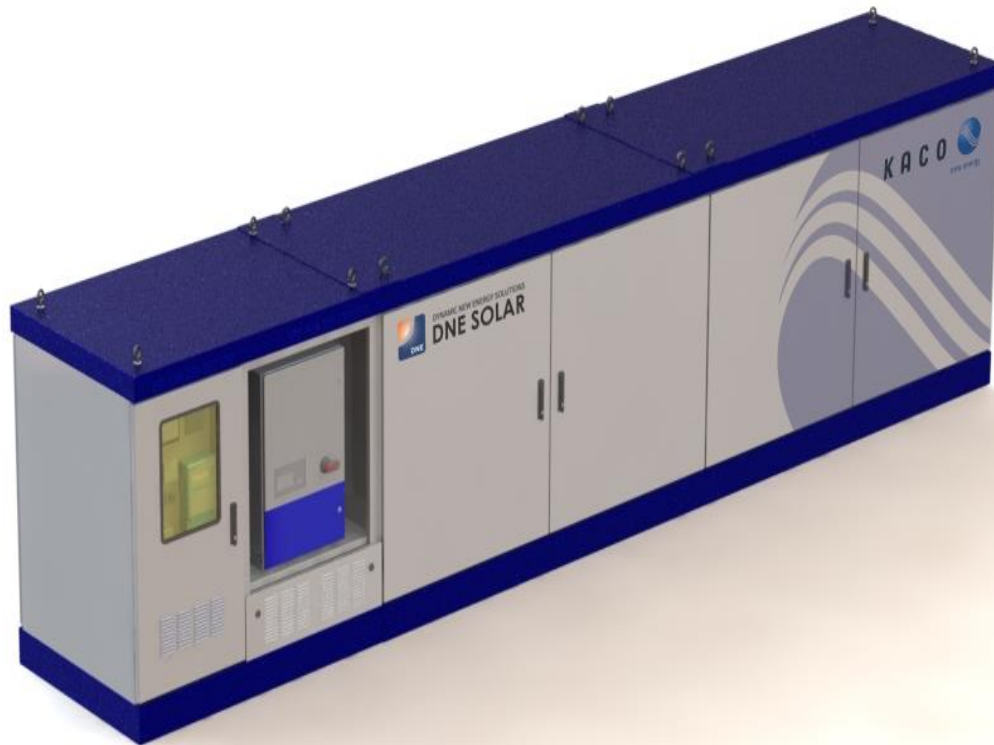
Redundancy



- Failure of an inverter does not lead to battery failure
- High system availability

South Korea

Smart Energy Storage System



300 kWh 2018.04
GoChang

2.7 MWh 2018.05
GoChang

200 kWh 2018.08
YoungCheon

400 kWh 2018.08
GyungSang

100 kWh 2018.09
BoRyung

South Africa

- Electricity Price Management
 - Peak Shaving at times of maximum demand in combination with solar PV
- Grid Management
 - Grid stability and energy resource management on utility and municipal level

MICRO CARE





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Thank You for Your Attention!

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