

# SMART HYBRID SYSTEMS

## LITHIUM / LEAD ACID STORAGE



ENGINEERED IN  
GERMANY

MADE IN  
GERMANY

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**PRODUCTS**

## BOS AT A GLANCE

- ▶ BOS provides smart decentralized energy systems covering 1-10kWh. Those systems combine innovative storage management and charge regulation with the capability to manage loads intelligently.
- ▶ BOS develops and integrates state of the art, smart energy management technology
- ▶ BOS patent protected hybrid battery management systems combine lead acid and  $\text{LiFePO}_4$  batteries. This solution lasts as long as Li-based batteries but is [20% - 70%] cheaper.

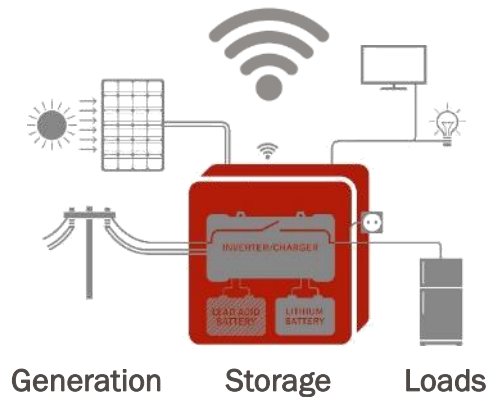


<sup>1</sup> Up to 40% if the whole system is installed new, 70% if the technology

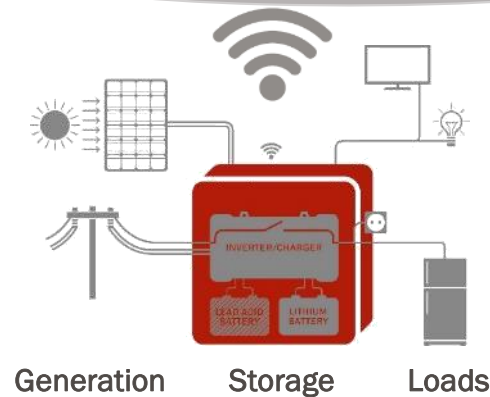
# EXPERTS IN DECENTRALIZED ENERGY MANAGEMENT AND INTEGRATION

- ▶ Integration of N number of systems under one cloud platform for easy control and payment management
- ▶ Control of power generation, inverters, batteries and loads through the integrated platform
- ▶ Unique link through electronic handshake & Payment via PayG for the solar system AND the loads (GSM based)

Backend / Remote Monitoring / PayG

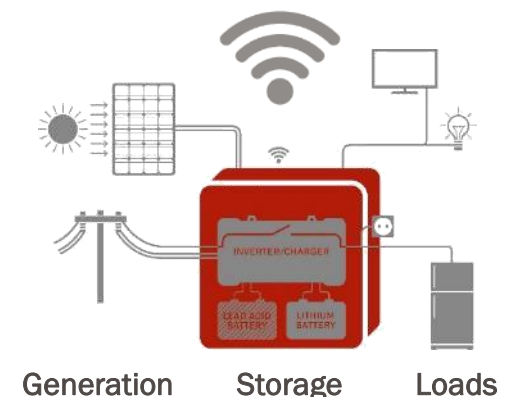


System 1 – 1-10kWh



System 2 – 1-10kWh

...



System n – 1-10kWh

# PRODUCT OVERVIEW

## Hybrid System Line (HS)

*Complete energy management and storage solution with built in lithium battery, (inverter/charger) and solar charge controller.*

- Capacity: 1000 – 10,000Wh
- 200W – 5kW
- Voltage: 24 – 48V



## Lithium Extension Line (LE)

*Li battery and smart controller transforming existing Lead Acid battery into high performance storage system.*

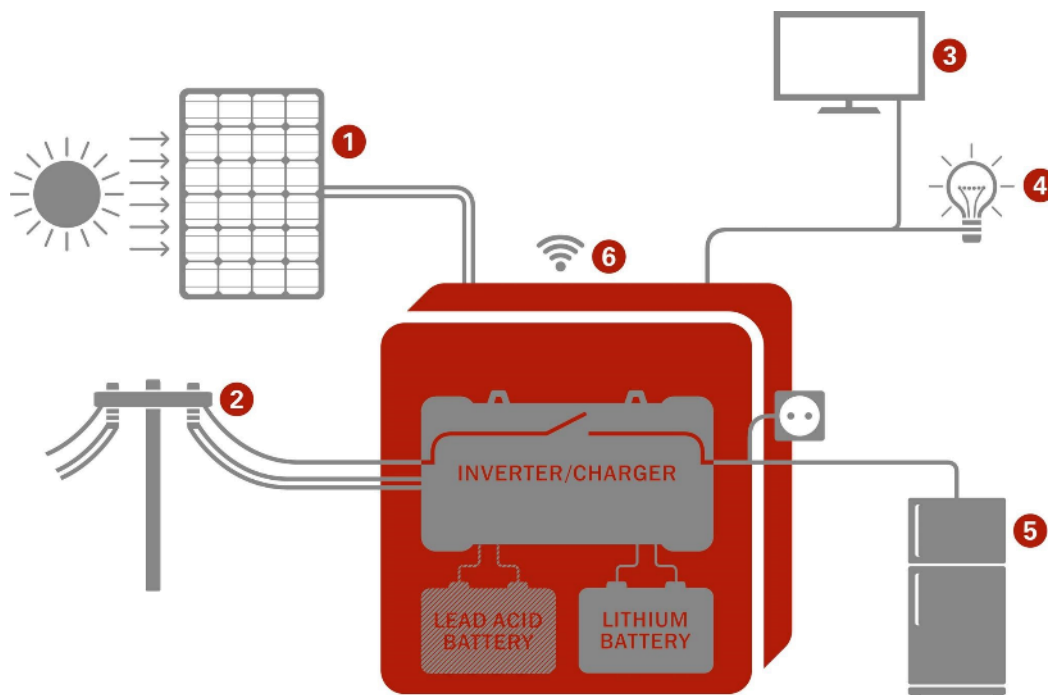
- System Capacity: 300 – 10,000Wh
- Voltage: 12 – 48V
- Amperage: 12,5A – 80A



Car industry  
certified



## A BRIEF LOOK IN TO HYBRID BACKUP SOLUTION



- 1 PV input, possibility to prioritise PV power for charging the system
- 2 Multiple AC Sources like utility grid, Diesel Generator can be integrated
- 3 Excess Energy output, a feature of our energy management
- 4 DC Output (12/24V) for efficient DC appliances
- 5 AC output (230V, 120V)
- 6 GSM connectivity for remote monitoring and PAYG functions

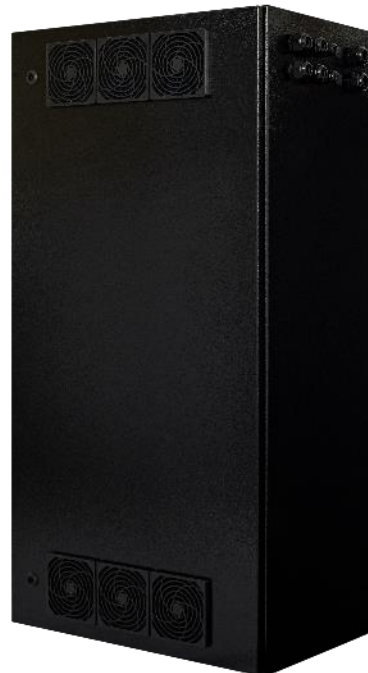
## **BOS UPS SYSTEMS: 2.5KWH/5KWH/10KWH INVERTER BASED PURE LITHIUM SYSTEMS (1/2)**

- ▶ The elegant solar power backup solution for powering AC loads
- ▶ An integrated solution housing MPPT charge controller, Inverter/Charger and Lithium battery
- ▶ Available with different size inverters and batteries
- ▶ Programmed to get best optimum performance from solar panels, utility grid, diesel generators and battery backup
- ▶ Remote monitoring capabilities with data logging
- ▶ PAYG enabled
- ▶ Inbuilt power management system which saves energy for the critical devices that need to be available 24/7!
- ▶ Can be stacked to reach bigger sizes



## BOS UPS SYSTEMS: 2.5KWH/5KWH/10KWH INVERTER BASED PURE LITHIUM SYSTEMS (2/2)

Typical Applications: Off-grid Solar home system, large scale backup, rural schools and hospitals electrification, micro utility AC mini-grids and rural electrification projects, holiday homes, hospitality, tourism and agriculture farms



# CUSTOMER EXAMPLE: RENSOURCE MARKET GRID SABON GARI / NIGERIA

- ▶ AC Mini Grid with >10.000 connection points
- ▶ 1.6 MWp installed PV and inverter capacity
- ▶ 1.6 MWh Li capacity
- ▶ 160 pcs. of HS10.000 installed in 22 clusters, linked with each other through diesel genset backup



## LITHIUM EXTENSION BATTERY (LE) (1/2)

- ▶ Based on same hybrid idea, another offering from BOS is Lithium Extension (LE)
- ▶ Is connected in parallel with the lead acid battery, enhancing performance and adding capacity to the lead acid battery, may it be solar home system or any energy storage system
- ▶ Available in 12/24\* voltage levels
- ▶ Scalable solution, capacity can be increased by simply connecting several packs in parallel
- ▶ Lead acid is charged with higher priority and while discharging, lithium is on higher priority. This helps to increase the lead acid battery life
- ▶ Retrofitting & extension of already installed systems without change in wiring or other components
- ▶ Works with any available standard lead acid charge controller /inverter (@12/24). No additional controller needed, simply connect directly to the lead acid batteries
- ▶ Lead acid battery is charged with higher priority, lithium battery is discharged first
- ▶ Lithium performance and lead acid cost advantages are combined

\* 24V needs a battery balancer

## LITHIUM EXTENSION BATTERY (LE) (2/2)

Typical Applications: Off-grid Solar home system, UPS and backup, motor homes and caravans, telcom towers and any application where lead acid is being used





# CUSTOMER EXAMPLE: HYMER RECREATIONAL VEHICLES

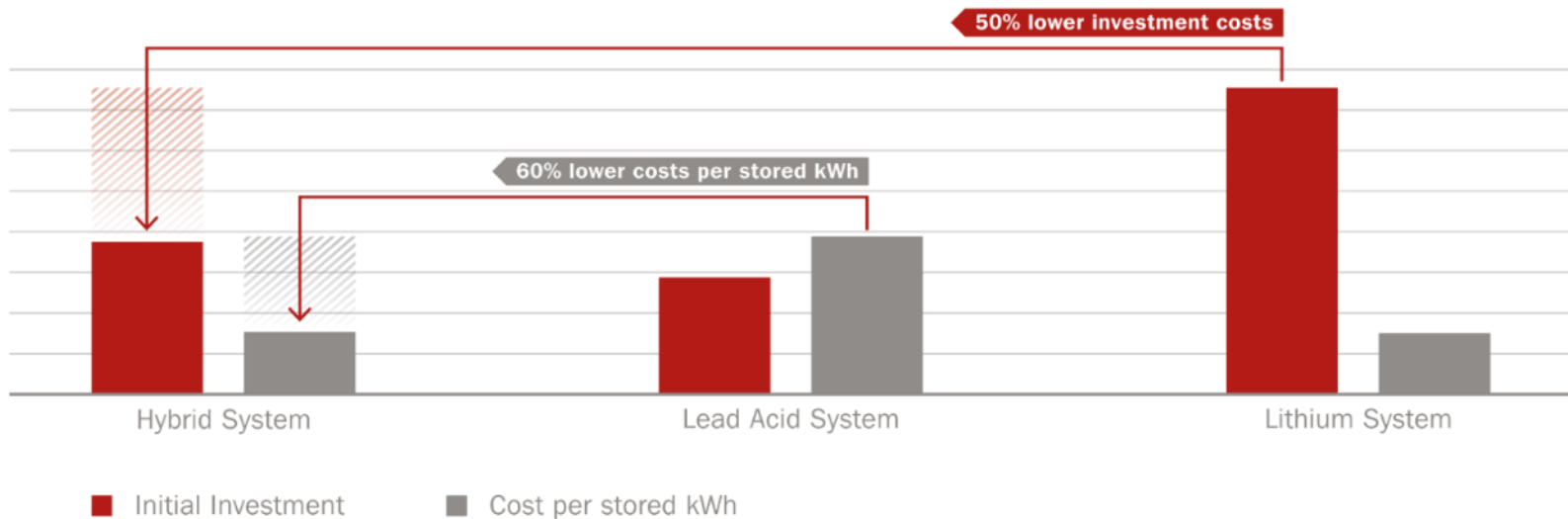
- ▶ >4000 LE300 sold and in use in Hymer caravans
- ▶ Offered co-branded by Hymer and BOS as HYMER SMART BATTERY SYSTEM, directly built in at Hymer assembly lines in Bad Waldsee
- ▶ LE300 certified according to car industry standards (related to LV124 and E24 certified)



# HYBRID SYSTEMS

## PROFITABILITY

- ▶ Investment costs close to lead acid systems
- ▶ Lithium like performance
- ▶ Increased system lifetime → more than 10 years for lead acid batteries

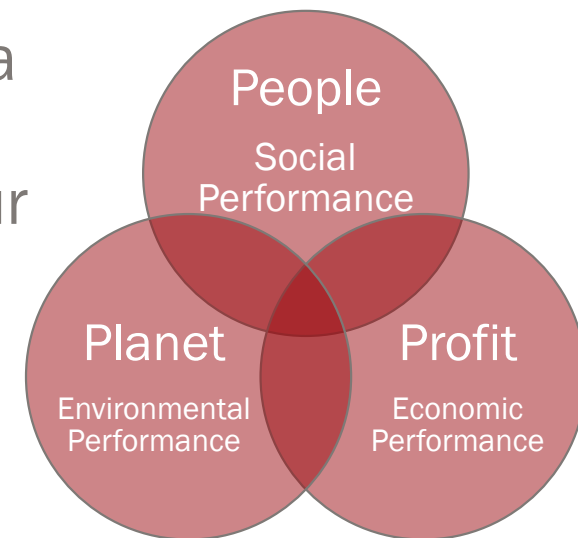




**TEAM**

# COMPANY INTRODUCTION

- ▶ BOS Balance of Storage Systems AG is a German based company, offering smart hybrid energy storage solutions. With our technologies, large parts of the off-grid community in developing and in industrial countries get access to high quality, long lasting & affordable energy solutions.
- ▶ BOS AG is working at the intersection where People, Planet and Profit meet. Optimizing our footprint and our return in each impact area is our strategical objective





# COMPANY FACTS

- ▶ Founded in 2014, market entry in 2015
- ▶ IP protected hybrid storage technology
- ▶ 20+ Employees
- ▶ Office location in Neu-Ulm, Germany
- ▶ Excellent know-how in power electronics and renewable energies
- ▶ Close link to universities in Ulm and Singapore
- ▶ Access to over 30 years of experience in battery storage and off-grid solar systems

# BOS CORE COMPETENCIES

- ▶ **Technology development**
  - BOS has patented its hybrid battery technology
  - BOS is working on the next generation of energy storage technologies, focussing on an integrated smart home solution featuring smart storage management, smart load management and smart data + payment integration
- ▶ **Product integration**
  - BOS competitive advantage is to integrate its technologies into products of its customers, offering tailored and state of the art solutions
- ▶ **Business development & key account management**
  - Continuous development of new businesses, whilst keeping close relations and continuous cooperation with existent customers is key to long term success
- ▶ **R&D to Mass Production**
  - Small batch manufacturing built up in an efficient and professional way, to offer very fast time to market for new product developments and high flexibility in case of specific customer requirements

# STRATEGIC INNOVATION & BUSINESS DEVELOPMENT CYCLE



## DYNAMIC TEAM STRUCTURE – HIGHEST FLEXIBILITY FOR OUR CUSTOMERS

- ▶ The BOS organisation is characterized through flat hierarchies
- ▶ Employees get „roles“ assigned and empowers them to make their own decisions and take over high responsibility
- ▶ Each Business Field/Department contains a „Lead Link“ Responsible who coordinates other members



- ▶ Benefits for our customers:
  - Fast reaction times to customer requests
  - High flexibility to changes/change requests
  - Dynamic and innovative organisation

# TEAM - MANAGEMENT



- ▶ Benjamin Seckinger (CEO) worked as Head Operations Manager for fosea (Pico PV manufacturer) when he saw the potential of this hybrid battery technology and decided to found BOS-AG. Ben worked in Africa and Asia. Ben is also the founder of engineers without borders Ulm/Neu-Ulm and lead the organization for several years. During his career Ben received the VDI award (association of german engineers), the CDG award (association for promotion of sustainability) and the IHK award of the Swabian Economy. Ben completed a Master in Advanced Management with a focus on finance and controlling and a Bachelor in Industrial Engineering with a focus on Energy Systems.



- ▶ Fabian Weber (Director Operations) has 7 years of experience in international operations and business development management, gained during his work for ASYS (<https://www.asys.de/agweb/>). He has a Bachelor of Industrial Engineering with a focus on Production management and extensive international work experience in Asia and the US. In BOS he is heading the operations department, managing the key account Hymer and the relations to key suppliers.

# TEAM - MANAGEMENT



- ▶ Thomas Kündiger (CTM) has more than 10 years working experience in mechanical engineering, tool-making and as CAD consultant. He has a Bachelor in Energy Systems and a Master in Systems Engineering & Management. He has proven his engineering and product development capacity with filing two patents for the technology of BOS. He is an expert in mechanics, CAD, product development and energy efficiency.



- ▶ Jennifer Schmeil (Director Business Development) is working for BOS AG since the foundation in 2014. During her job career Jennifer was working for 8 years within the BOSCH group as an international project manager, managing big customer projects. Jennifer's experiences in international sales activities are based on her work as a Sales Manager for Paul Hartmann AG where she was employed for 4 years. Jennifer has a diploma in foreign trade and economics.

# TEAM – OPERATIONS



André Schuhmacher  
Head of Quality  
Certifications, quality  
management and  
quality control



Michael Schmid  
Electronics engineer  
Software and hardware  
specialist with systems  
experience



Philipp Engel  
Systems engineer  
Systems engineer with  
background in quality and  
process optimization



Hannes Baumgartner  
Supply Chain  
Management  
Procurement & Supply  
chain management



Lars Rupp  
Electronics engineer  
Senior software and  
hardware specialist  
with QC testing strength



Arthur Kleer  
Production  
Production engineering  
and management



Leesa Komanapalli  
Marketing and Sales  
Operational and  
strategic marketing,  
promotion and sales



Markus Schwientek  
Electronics engineer  
Software and hardware  
specialist with strength  
in documentation



Veeresh Anehosur  
Business Development  
International business  
development and  
projects, based in India



Oliver Haist  
Operations  
Management & IT  
Key account and IT  
support



Andreas Braun  
Systems engineer  
Electric systems  
engineer with strong  
practical background



Sarah Lohr  
Accounting and HR  
Operational accounting,  
HR and back office work



# TEAM - SUPERVISORY BOARD & INVESTORS



Prof. Peter Adelmann has been active in PV since 1983. He is Professor for solar energy and has been teaching in Ulm since 1988. In 1990 he founded the solar department in Steca GmbH. In 2000 he founded Phocos AG and was its CEO until 2008. Since 2005 he has been a member of the IEC norming committee (WG3 – solar components). Since 2008 he is Senior Consultant of GIZ, Worldbank, BOSCH and other leading companies or donors. He is supervisory board chairperson of BOS AG.



Dr. Erik Sauar is the former CTO of REC Solar AG and has extensive technical and management expertise in the solar industry. Dr. Kjetil Roine has extensive experience in the energy and carbon market. He was Head of Research Analysis at Point Carbon for several years. Both, Erik and Kjetil have excellent contacts in the solar industry and are business angels in BOS AG with their investment group “Differ A.S.” (<http://www.differgroup.com/home/>). Kjetil is a supervisory board member of BOS AG.



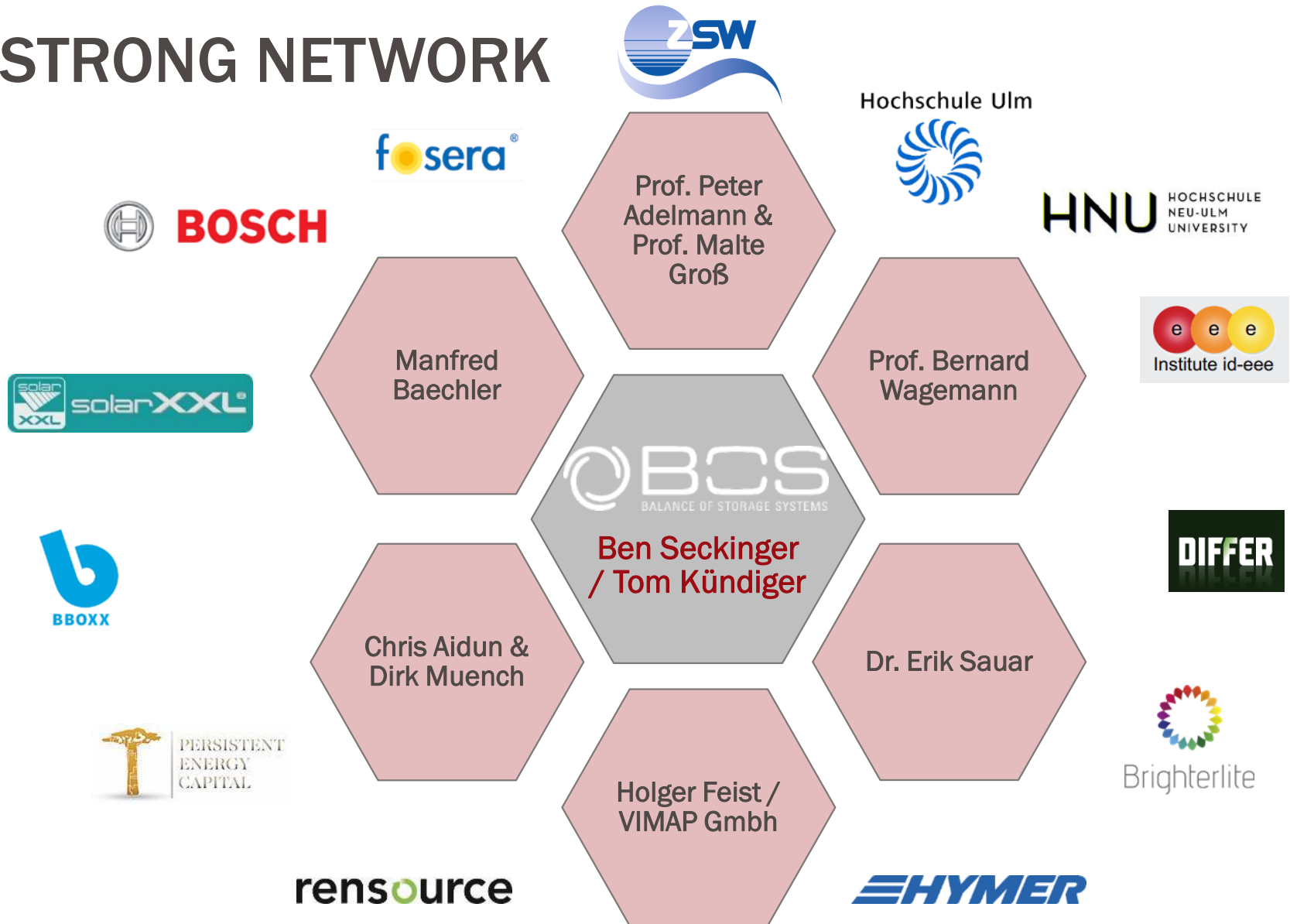
Manfred Bächler is working in the fields of photovoltaic since more than 25 years. He accompanied as a CTO the growth of Phoenix Solar AG (<http://www.phoenixsolar-group.com/de.html>) from a small start-up to a stock-listed company with more than 300 employees on 4 continents. Currently he is managing director of reniva GmbH and PerVorm. Manfred Bächler is in the supervisory board & one of the business angels in BOS AG.



Dirk Münch is Co-founder and Managing Partner of Persistent Energy Capital (PEC). PEC partners with businesses providing energy and other services to off-grid customers in sub-Saharan Africa. He has been one of the first to recognize the transforming potential of PayG technology and one of the first investors in this sector. Christopher Aidun is the CEO of Persistent, Chris has overseen over 50 investments in his 5 years in the sector. Prior to that, Chris spent 30 years as a private equity and finance lawyer for an international law firm. Chris is a supervisory board member of BOS AG.



# STRONG NETWORK





# CONTACT

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