



# **New generation of saltwater batteries**

**Dr. Thomas Krause**

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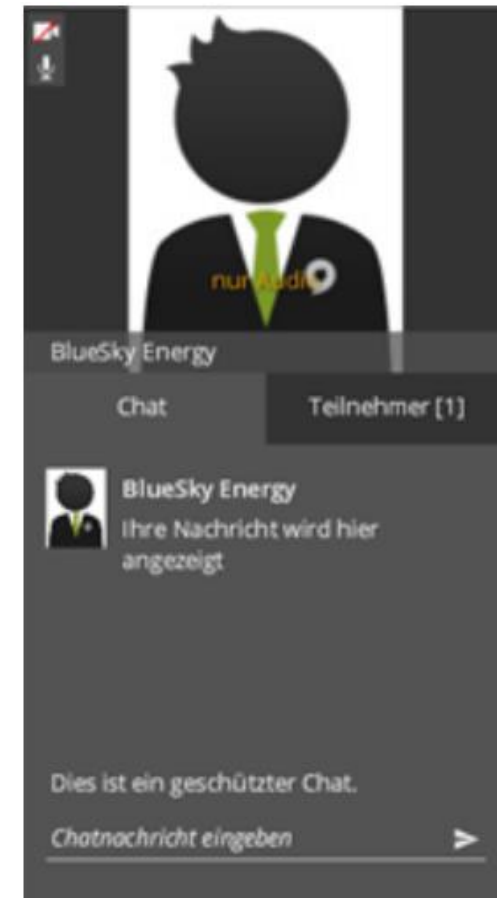
Dr. Thomas Krause

## Basics about the webinar

Participant List and Chat are not shown for every participant

Please ask questions via the chat, at the end of the topic those questions will be addressed

please take part in the survey after the webinar, this enables us to improve, based on your feedback





## Presenter at this webinar

Dr. Thomas Krausse

Managing Director – BlueSky Energy GmbH





## About BlueSky Energy

Founded in 2012

Focus on electrical energy storage solution

Complete Plug&Play solution with its GREENROCK product line (including inverters, EMS) (5 kWh – 30 kWh)

GREENROCK Commercial & Industrial Solution, plug&play from 30 kWh to 180 kWh

Saltwater based electrical energy storage „cells“ (stacks)



## A good battery.....

- ✓ Takes years to test
- ✓ Holds up to the promises in the Marketing brochures
- ✓ Is operating effectively in a wide condition range (temperature, depth of discharge (DoD), C-Rate, ....)



# New generation saltwater battery

- ✓ Only proven technologies in real life applications
- ✓ you order today – ship tomorrow = exceeding expectations instead of over announcement

# New generation saltwater battery



# **New generation saltwater battery advantages....**

- ✓ Scalable from 2,7 kWh to MWh applications
- ✓ 100% DoD (without harming the battery)
- ✓ Non toxic, all natural materials
- ✓ No supply chain risk
- ✓ Non inflammable, non explosive
- ✓ Maintenance Free
- ✓ Wide temperature range from -5° to 50° Celsius
- ✓ No transport restrictions



# New generation saltwater battery weakness....

- ✓ Energy Density (twice as big than comparabe Lithium technologies)
- ✓ C-Rate (0,5 C )

# Data summary of the 48V saltwater stack

Nominal Energy	2,7 kWh (4A charge/discharge)
Nominal Voltage	DC 48 V
Voltage Range	35 V – 60 V
Charging	CC (constant current)
Depth of Discharge	100%
Efficiency	>85%
Maximum charge current	20A
Maximum discharge current	20A
Operating temperature	-5°C – 50°C
Storage temperature	-5°C – 50°C
Cycle Life	5.000 cycles @ 80% DoD

# Data summary of the 24V saltwater stack

Nominal Energy	2,7 kWh (8A charge/discharge)
Nominal Voltage	DC 24 V
Voltage Range	17,5 V – 30 V
Charging	CC (constant current)
Depth of Discharge	100%
Efficiency	88,5%
Maximum charge current	40A
Maximum discharge current	40A
Operating temperature	-5°C – 50°C
Storage temperature	-5°C – 50°C
Cycle Life	5.000 cycles @ 80% DoD

# **The new generation saltwater battery - chemistry overview**

- ✓ Anode: Sodium
- ✓ Cathode: Manganese-Oxide
- ✓ Electrolyte: „Saltwater“ - Sodium Sulfate + Water (H<sub>2</sub>O)
- ✓ Separator: Synthetic paper
- ✓ Current Collector: Stainless steel
- ✓ Housing: Plastic Housing

## What about Cycles?

- ✓ 3.500 cycles @ 100% DoD and 70% remaining capacity or
- ✓ 5.000 cycles @ 80% DoD and 70% remaining capacity or
- ✓ 10.000 cycles @ 50% DoD and 70% remaining capacity or
- ✓ 20.000 cycles @ 25% DoD and 70% remaining capacity.....



# **New generation saltwater battery Instead of Cycles – Energy Throughput**

- ✓ Energy Throughput in kWh..... 22.030 kWh @ 80% DoD
- ✓ @ 25 degree C
- ✓ @ 5A/5A charge/discharge

# New generation saltwater battery

## Temperature

- ✓ Temperature impacts on storage capacity and round trip efficiency
- ✓ Optimal temperature range between 15°C and 30°C
- ✓ >30° C storage capacity and round trip efficiency improve
- ✓ >50° C potential detrimental effects on lifetime (although no harm)
- ✓ @ 0° C capacity is at 65% of nominal capacity



# **New generation saltwater battery Testing**

- ✓ Overcharge Testing – 500 hours @ > 40% above nominal voltage – no harm to battery
- ✓ Short Circuit Testing (UL 1973-14)
- ✓ Gas Evolution Testing
- ✓ Imbalanced Charging Testing (UL 1973-17)



# Dimensioning.....

## How big should the storage be?

- ✓ What is the purpose of the storage? - Emergency back-up or PV optimization?
- ✓ **Emergency backup:** consumption in kWh x desired time for backup = size of storage
- ✓ **PV optimization** = rule of thumb = size of PV in kWp = size of storage in kWh
- ✓ **PV optimization** = rule of thumb = size of PV in kWp x **1,5** = size of storage in kWh
- ✓ Details like load profiles during day/night, specific bigger consumers, seasonal effects

# New generation saltwater battery



## Comparing to lead batteries 1/2

- ✓ Upfront investment based on EUR or USD per kWh tends to be higher
- ✓ Saltwater battery = nominal storage = usable storage
- ✓ Lead batteries tend to have less usable storage than nominal storage (depending on technology used)
- ✓ Important to compare usable storage to usable storage

# New generation saltwater battery



## Comparing to lead batteries 2/2

- ✓ No maintenance for saltwater batteries
- ✓ Saltwater batteries are flexible on the temperature range (-5 to 50 degree C)
- ✓ Amortisation after 2-3 years depending on application
- ✓ No special end of life costs (waste handling)

# New generation saltwater battery



## Comparing to lithium batteries 1/2

- ✓ Upfront investment based on EUR or USD per kWh tends to be equal
- ✓ Saltwater battery = nominal storage = usable storage
- ✓ Lithium batteries tend to have less usable storage than nominal storage (depending on technology used)
- ✓ Important to compare usable storage to usable storage

# **New generation saltwater battery**

## **Comparing to lithium batteries 2/2**

- ✓ No transport restrictions for saltwater batteries
- ✓ Saltwater batteries are flexible on the temperature range (-5 to 50 degree C)
- ✓ No supply chain risk (no rare metals used in the production process)
- ✓ No special end of life costs (waste handling)



# New generation saltwater battery - Which inverter to use.....

- ✓ PV-inverter (to be used as usually done)
- ✓ Battery inverter – 48 Volt nominal voltage, Inverter's charge profile need to set – as it is the case with lead batteries...
- ✓ Constant Current (CC) charging – 60 Volt charge cut off voltage
- ✓ After charge voltage is reached, change to 54 V float voltage
- ✓ Absorbition time = zero
- ✓ No need for equalize voltage/time

e.g. Victron, Studer, Outback Power, FSP, SMA already used

# New generation saltwater battery



## Battery Management System (BMS)

- ✓ Voltage Range from 48 Volts to 500 Volts (other voltage ranges to be discussed)
- ✓ Balancing on Battery Stack Level
- ✓ Balancing of Cut-off voltages
- ✓ Ideal to mid-to larger scale storage applications
- ✓ Ensures a robust storage applications by levelling of differences between single stacks

# The new generation saltwater battery

## Energy Management System (EMS)

- ✓ Plug & Play as an option to add
- ✓ Peak Shaving...
- ✓ Storage Clustering
- ✓ Easy Integration of multiple sources (Wind, PV, Diesel generator, CHP...)
- ✓ Integration of E-Charging Systems, Power – to – heat function,
- ✓ Online and Offline battery control (e.g. temperature, State of charge)



# The new generation saltwater battery

## Small scale storage

- ✓ Capacity: 675 Wh @ 4A/4A
- ✓ Nominal Voltage: 12 V
- ✓ Voltage range: 8,8 V – 15 V
  
- ✓ Height: 235 mm
- ✓ Width: 313 mm
- ✓ Depth: 329 mm
- ✓ Weight: 35 kg





# The new generation saltwater battery

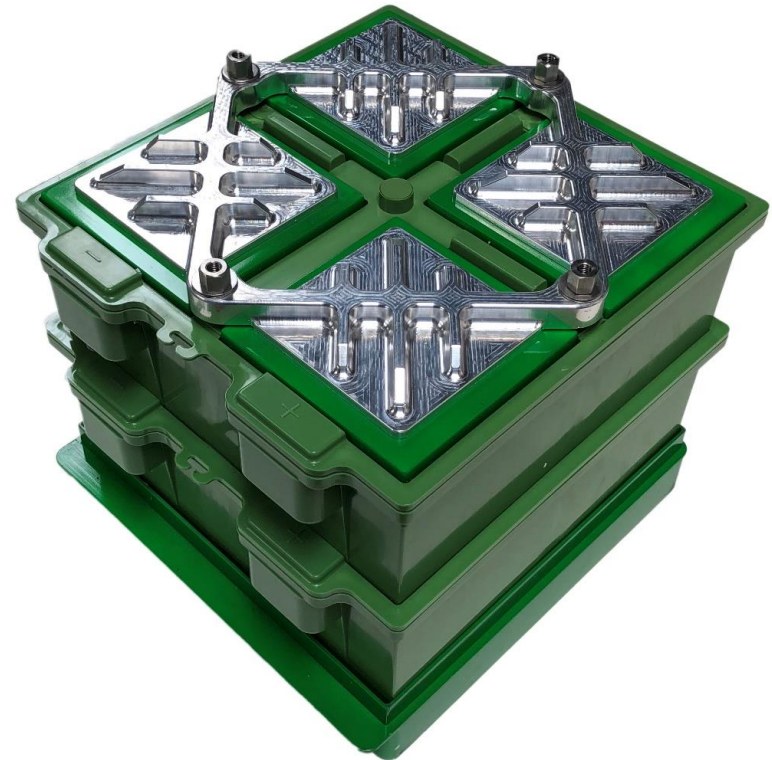
## Off-Grid = Perfect fit

- ✓ Experienced and proven in Island Mode applications
- ✓ Robust, Wide Temperature Range, Maintenance Free....
- ✓ EMS works offline & online to provide remote access but ensure autarc processing
- ✓ 100% DoD ensures full flexibility
- ✓ With infrared heating application usable and applied up to -30° C
- ✓ Low rate of self discharge



# The new generation saltwater battery Warranty

5 years warranty  
+ 3 years time value warranty  
= total 8 years warranty  
5000 cycles @ 80% DoD





# **The new generation saltwater battery Next steps.....**

Energy Density

Energy Throughput

C-Rate



# **The new generation saltwater battery future steps.....**

Refillable Saltwater Battery...

Materials recycle – reclamation of un-degraded stack material



# Meet us at ees Munich

20th to 22nd of June

Hall C1

Booth 210



# References

