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Why software is key for safe, efficient and profitable operations of BESS.

Dr. Stephan Rohr, Co-CEO of TWAICE

www.twaice.com

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# **Relevance of BESS in the Energy Transition**

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### **Relevance of BESS in the Energy Transition**



#### Utility/Grid-Scale



C&I



Electricity generation and distribution

- Price arbitrage
- Capacity payments
- Ancillary service markets
- 0 ...
  - ~ 10 MWh 1000 MWh



Commercial & Industrial applications

- Peak shaving
- Self-consumption optimization
- Charging infrastructure

0 ...

~ 1 MWh



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Home applications

- Renewable integration (rooftop PV)
- EV charging infrastructure

0 ...

#### ~ 0.01 MWh

#### **Relevance of BESS in the Energy Transition**



**Global Cumulative Installed Battery Capacity [GWh]** 





# **Energy Neighbor**

Der dezentrale stationäre Beiterlespeicher Energy Neighbor at ein retzdiontich eingesetzter Energiesprecher in der 400 V Ortaretzsbere. Er wird mit besonders sicherer und lengebigen Litram-Eserphrosphat-Zallen (L/FePQ) aufgebaut.

 Americang Expresentation, Hepdelaterg, Notor-Natureg
 Entrative 400 V Medemportungsants
 Americangeri co. 5 x 23 x 2,4 Melov
 Energovitum, 300 value Leitung (XAW)
 Bols Butterill
 Mitchenklingslorung
 Mitchenklingslorung
 Literatuur (De 20 Jeles)



Erneuerbare Energien lokal erzeugen, lokal speichern, lokal nutzen.

# 0.2MWh

**Grid Storage** 

Gefördert durch: Bayerisches Staatsmänisterium für Wirtschaft und Medien, Energie und Technologie





Der dazenfrale stationäre Battericspeicher Energy teightor ist ein netzdienlich eingesetzter Energesprecher in der 400 V Ottaretzobere. Er wird mit besorders sicheren und leightiger Lithern-Ereitrisphosphar-Zalien (LiFePO) aufgebaut.

 Amendung Szymweltrach, Hepdischen, Notoritationg
 Emitte in 400 V Medersponungsists
 Albressonger co. 5 x 7,3 x 7,4 Meter
 Ebergenburg 30,5 vgs

Leitung (KAW
 Hots Robusting)
 Mitchanitik (Kawa)
 Mitchanitik (Kawa)
 Mitchanitik (Kawa)
 Lister Kahang
 Lister Kahang
 Lister Kahang
 Lister Kahang



### Average size of grid-connected BESS in MWh



# **1.8 billion** data points

generates

one BESS

In one day

#### **Different applications of software to run & improve BESS**



#### Addressing the technical challenges of BESS





### **Challenges of Commissioning**

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Faulty installation & production defects remain major drivers of BESS failures





### **Challenges of Commissioning**

Weak Spots & Defects



Manual effort and a lack of deep insights into the battery hinder an efficient and effective commissioning



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#### **Case study: Digital Commissioning**

How TWAICE's Digital Commissioning helps Austria's leading energy provider (Verbund) to scale their BESS business.



Connector issue fixed on-site



Verbund TWAICE

"TWAICE Digital Commissioning helps us to overcome the challenges posed by an increasingly heterogeneous system integrator landscape and ever larger BESS. Battery analytics software is a must-have for baselining performance at beginning of life and identifying deficiencies before operation starts."

- Karl Potz, Head of Battery Solutions at VERBUND



#### **Challenges of Performance & Availability**

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#### **82%** Ø BM<sup>1</sup> availability (UK)

"Unplanned downtime led to an average availability across our fleet of only 84% last year"

#### US asset owner

#### **Challenges of Performance & Availability**



The business case after commissioning is driven by the availability, roundtrip efficiency and lifetime of a storage



#### **Challenges of Performance & Availability**

Get granular insights into your storage system & find where the problems are



#### **Example: LFP SoC Estimation – BMS Failure**



#### Example from a >400 MWh system – CASIO market

#### Indicators:

 BMS SoC is jumping by more than 10%, especially at the end of the SoC ranges

#### **Consequences:**

- Sudden interruption of operation
- Revenue loss and potential penalties
- Downtime due to component failures such as inverter tripping



Revenue loss, penalties and reduced availability can be avoided by leveraging better State of Charge calculations which highlight the uncertainty and errors of the BMS SoC

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#### Avoiding the worst case scenario is at the top of mind of many ESS managers – rightly so



#### **US** integrator

Even with proven product designs and extensive safety testing, at the scale that storage is being deployed, we would be naïve to assume safety incidents won't happen.

#### Commissioning

Performance & Availability



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TWAICE can prevent most fire events, benefitting clients and insurers alike

# 70 fires

Despite existing fire prevention and mitigation measures, severe thermal events continue to happen - a total of c. 70 fires are captured in EPRI database, and the number of unreported minor incidents can only be estimated

# 87% caused by battery internal

#### events

Investigating the causes for failure we see that almost 90% of the incidents are caused by battery internal events

# Incidents can be detected and avoided

This analysis suggests that most of these incidents could have been detected and avoided with battery analytics by TWAICE

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Existing issues only provide the last layer of safety – early detection is required



Get notified of safety-critical incidents by email & view on the incident log

afety M	onito	ring & Ana	alytics Beta ver	sion ①					Incident rules
Overview 12,483	of 12,483	📋 Critical	<b>O</b> of 0	A High	336 of 336	9 Medium	2,758 of 2,758	Now	<b>9,389</b> of 9,389
Severity y 17	Message		Storage V	Component 57	Sensor 17	Start y 9	End v V	Duration 🗸 🕫	Explore
P.	String Module exceeded the 10.00°C.	e Temperature Min lower threshold	Green Alfons	String 1.2.3	String Module Temperature Mil	February 02, 2024	Ongoing	<u>(</u> )	→
P.	String Module exceeded the 10.00°C.	e Temperature Min lower threshold	Verlee	String 1.2.5	String Module Temperature Min	February 02, 2024 n 08:24	February 02, 2024 08:24	4 0 Secs	÷
p.	String Module exceeded the 10.00°C.	e Temperature Min lower threshold	Stromquelle	String 1.2.9	String Module Temperature Min	February 02, 2024 n 06:42	<ul> <li>Ongoing</li> </ul>	(i)	÷
p.	String Module exceeded the 10.00°C.	e Temperature Min lower threshold	Green Alfons	String 1.3.10	String Module Temperature Min	February 02, 2024 n 05:33	<ul> <li>Ongoing</li> </ul>	©	→
14	String Module exceeded the	e Temperature Min lower threshold	Verlee	String 1.2.10	String Module	February 02, 2024	Ongoing	(i)	<i>→</i>

### **Example: Different DCR peaks observed in histogram**

#### Example from a 400 MWh system

#### 380 of strings 285 190 DCR shows two different ā 95 distributions in the histogram

#### **Consequences:**

**Indicators:** 

0

- Different root causes :
  - Connector issue within 0 inverter 2 which leads to higher resistance
  - Same cell type installed in 0 BESS, but different cell quality, relevant for warranty claims





#### **Challenges of Warranty Coverage**





#### **Challenges of Warranty Coverage**

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Tracking the warranty status is not as simple as it seems



Heterogeneity

Static Coverage

**Unclear Status & Claims** 

#### **Reduce warranty risks**

Steer your operation within warranty limits & pro-actively manage warranty cases

<b>N TWAICE</b>	warranty fracker					energy@twaice.com 🗸
	STORAGE SYSTEM OVERVIEW					
	INFORMATION	CURRENT STATE OF HEALTH	WARRANTY-RELEVANT FULL CYCLES	AVG RESTING STATE OF CHARGE	AVERAGE TEMPERATURE	
	Client Penalty Execution Demo Client Cycles	96,2%	286	49,1%	26 ∘c	
	Initial Capacity Power Initial Bettery Capacity 10 mWh 10 mW Samsung SDI 94 Ah	Warranty-reference Difference 97,4% - 1,2%	Warranty-reference Difference 200 86			_
	TIMELINE	Warranty Beginning 15.11.2020 TODAY			Warranty End 15.11.2027	_
	SYSTEM NAVIGATION:         STORAGE: Demo         / INVI           STATE OF HEALTH	ERTER: Select ~	SYSTEM VIEW: De Aggregation	Worst     CUMENT 10H     OX2021     OX2021     OX2021	EASED ON LEVEL: Rack	
	CYCLES	DEMO STORAGE		WARRANTY RELEVANT CYCLES		_
	EQUIVALENT FULL CYCLES 254 PENALTY 32	300				_
	WARRANTY-RELEVANT CYCLES 286 WARRANTY REFERENCE 200	200			286	
	DEVIATION TO WARRANTY - 86	0	2020 012021 02/2021	03/2021 04/20	221 <b>TODAY</b>	_
	STATE OF CHARGE	DEMO STORAGE				_
	AVG CENTRAL SOC 48.2%	70%		MINE DAILY RESTING SOC	AVG. DALY RESTING SOC	

#### Addressing the technical challenges of BESS





Leading software solutions to successfully design, validate and operate batteries at scale.

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# Unleash the Full Potential of Batteries

Verbund	ju:niz	SW//M	<b>TÜVRheinland</b>
sembcorp		<b>UENCE</b> <sup>®</sup> A Siemens and AES Company	Gore Street Capital
pepper		Mercedes-Benz	Nobina
30+	Patents		
1	Onsite ba	attery research ce	enter
2	Offices ir	n Munich (HQ), Cł	nicago (US)
140+	and data	scientists	are engineers

