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volytica diagnostics

20 September 2023

8:00 am – 9:00 am | CST, Mexico City
10:00 am -11:00 am | EDT, New York City
4:00 pm – 5:00 pm | CEST, Berlin

pv magazine
webinars

BESS diagnostics for holistic lifecycle management



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Welcome!

Do you have any questions? ? 

Send them in via the Q&A tab.  We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 

We'll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience.  



BESS Diagnostic for reducing O&M cost and becoming peak hunter



BESS: the new resource for the system

Main drivers for development

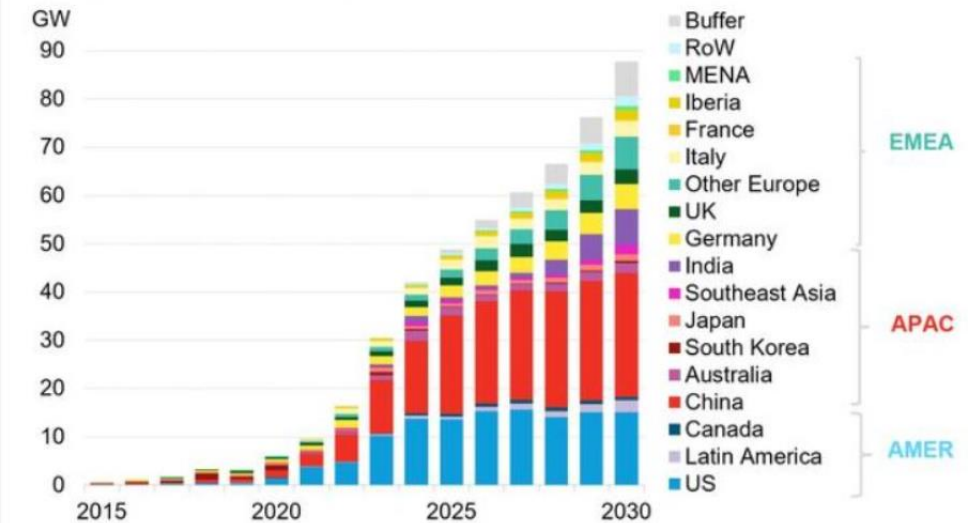
Current market trends in various geographies are creating growing opportunities for energy storage developments

- ❑ **Increasing RES penetration:** solar and wind dominate the future of electricity increasing volatility and mismatch of power demand and supply
- ❑ **Phase out synchronous capacity,** mainly coal driven by long term decarbonisation goals to fight climate change
- ❑ Diffusion of **small scale embedded generation**
- ❑ **Decreasing battery costs** (driven by EV), makes BESS competitive with gas peaker plants
- ❑ **Regulatory frameworks already present in some countries** allowing energy storage to operate in the energy markets, not without significant challenges
- ❑ Specific mandates are being launched in different countries with **incentives for energy storage** which can act as a core driver for short term deployment based on financial support

Battery storage will be a key component of the electricity system of the future

BUT IT'S REALITY ALREADY

Global gross energy storage capacity additions by key market



- **Over 26GW in operation within 2025**
- **23% annual growth until 2025**
- **Capacity doubled since 2020 report by BNEF**
- **Year 2025:**
 - **USA ~ 38% of capacity**



Why BESS in Enel Green Power?

Provide a wide range of services, both to plant and to the grid



Storage coupled with Renewables



Stand-alone grid connected

Coupled with RES

Front-of-the-meter

Imbalance costs savings

Curtailment reduction

Energy shifting/arbitrage

Frequency control

Grid and plant services

Spin/Non spin reserve

Arbitrage

Frequency control

Applications for:



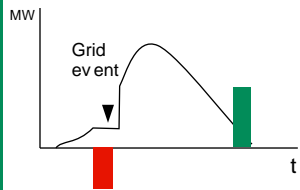
Power Plant



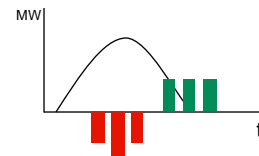
Power plant and Grid



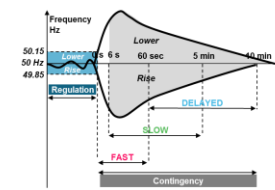
Grid



Recovery of power plant production (otherwise lost) due to **grid curtailment**

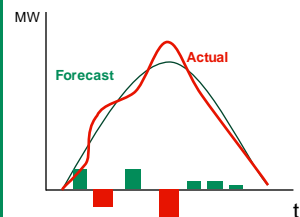


To charge and discharge battery in order to **move plant production** in hours where **energy has more value**



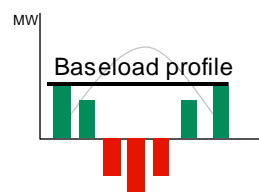
To help **grid stability** following a **grid event** in order to bring back system *frequency* within safe parameters

Curtailment reduction



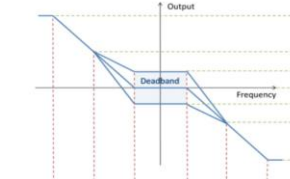
Battery charge and discharge in order to **nullify differences** between power plant **production forecast** and **actual real time production**, so **avoiding balancing costs**

Imbalance costs savings



To transform plant typical profile production into a **baseload profile** or to **match offtaker load**

Energy Shifting/Arbitrage



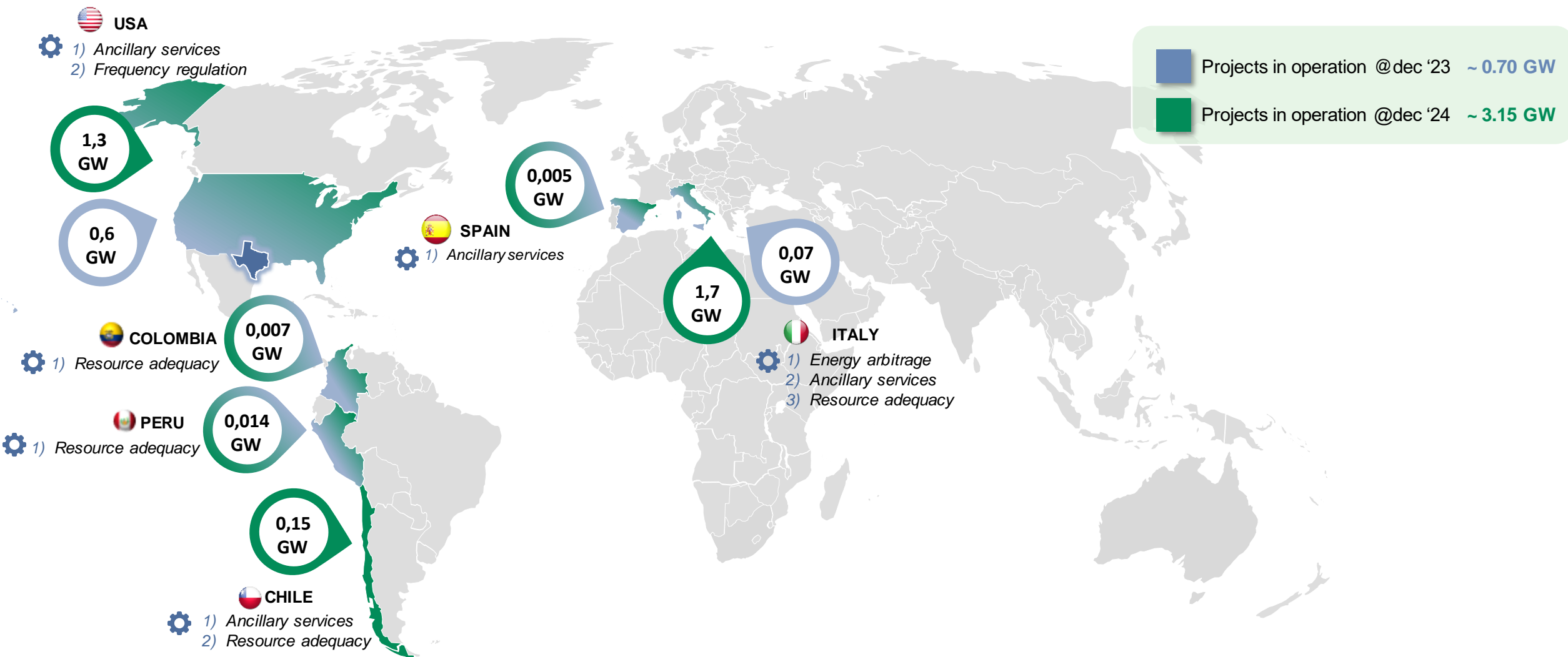
Service provided to the grid in order to improve **system reliability**. Awarded on a competitive auction.

Frequency control



Enel Green Power Energy Storage Footprint

BESS Projects in operations @dec'23 vs @dec'24





Most recent BESS benefits

Grid emergency response

Batteries added to Texas power grid this summer may have helped avert blackouts, companies say

KEEPING THE LIGHTS ON IN ERCOT

Enel helped prevent a grid emergency in Texas

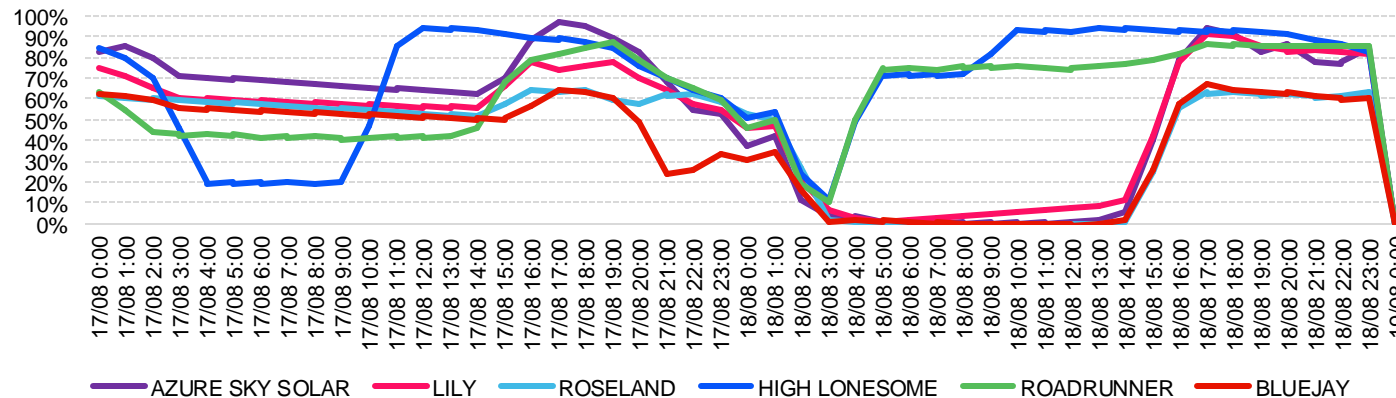
- 22.9 GWh** Wind & solar electricity generated throughout the day
- 320 MWh** Electricity delivered from seven dispatchable storage projects from 5-11pm
- 125 MW** Critical load relief requested from Enel's demand response portfolio

Performance on 08/17/2023



Battery power on grid set to triple

Enel boosts storage to 520 megawatts





BESS growth

Challenges to be overcome

- Supply chain challenges
- Lack of knowledge and experience on batteries
- O&M strategies vs Market Opportunities (peak hunters vs continuous availability model)
- Degradation of the batteries vs Market Opportunities



Supply chain crisis has disrupted the BESS industry



...but outlook is improving

Logistical challenges

Delays and higher transportation cost

Lockdowns and Russia-Ukraine war affect port handling and shipping causing transportation delays and freight price increases

Raw Material

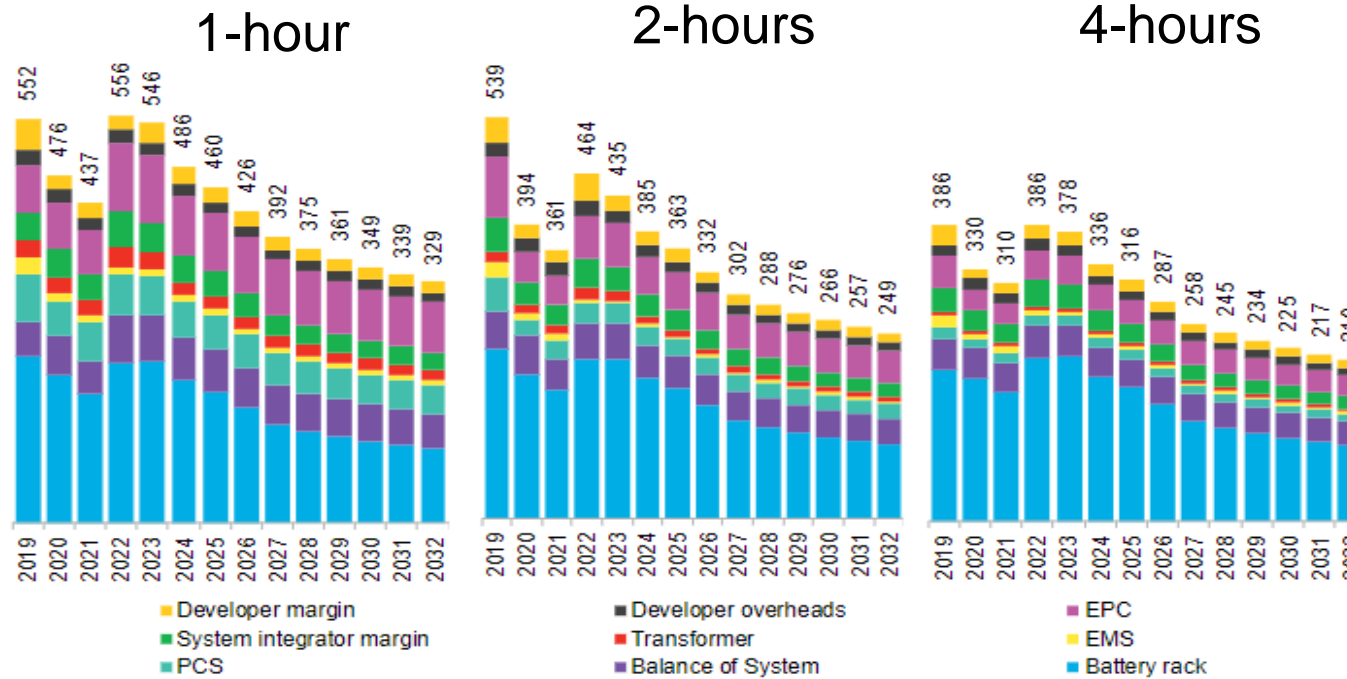
Scarcity and Price Volatility

Limited raw material supply increases price and volatility of battery metals (especially lithium carbonate)

Explosive demand EV

Battery shortage

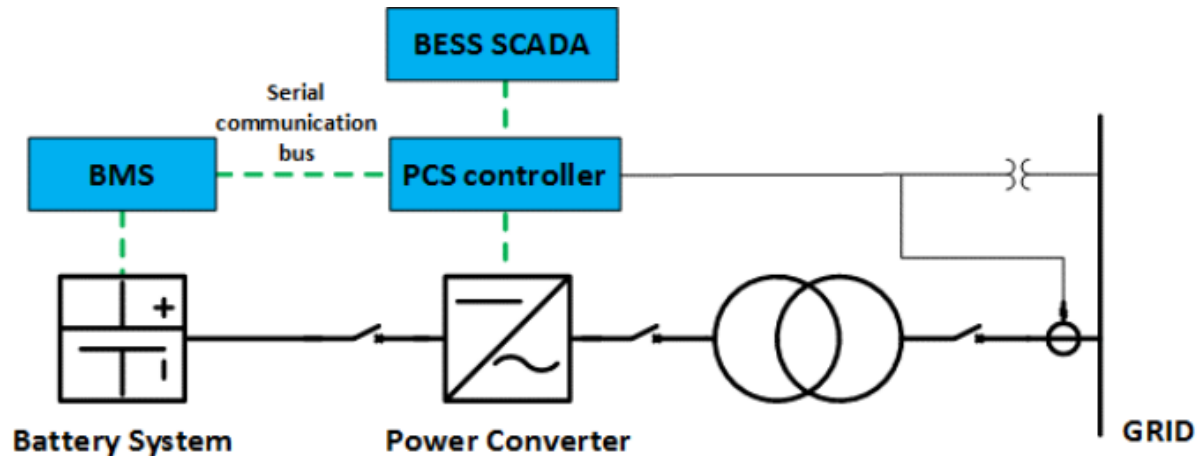
Increase in EV demand, leads large EV manufacturer to gobble-up cell production capacity, resulting in little availability for stationary storage



Source: BloombergNEF, survey responses. Note: Prices for 2022 are based on survey responses up to November 2022.



Main BESS Components



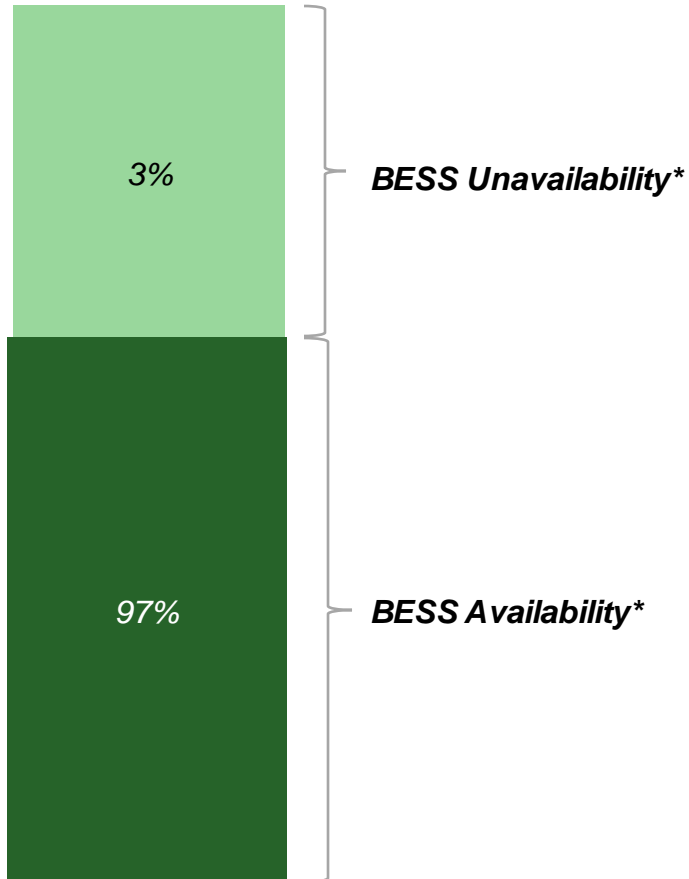
- High knowledge and experience on electrical equipments from LV to HV
- Need to improve competencies and experience on lithium batteries. System integrators are not always able to provide it and OEM of batteries are not always interested in O&M activities.
- Need to rely on a technical specialist of a third party in batteries



O&M strategies vs Market Opportunities

“Peak hunters” vs continuous availability strategy

BESS Availability Estimation



*Yearly Outages: calculated based on maintenance plan man-hours and the expected failure rate for the main BESS Systems



Capacity Market 24 in Italy

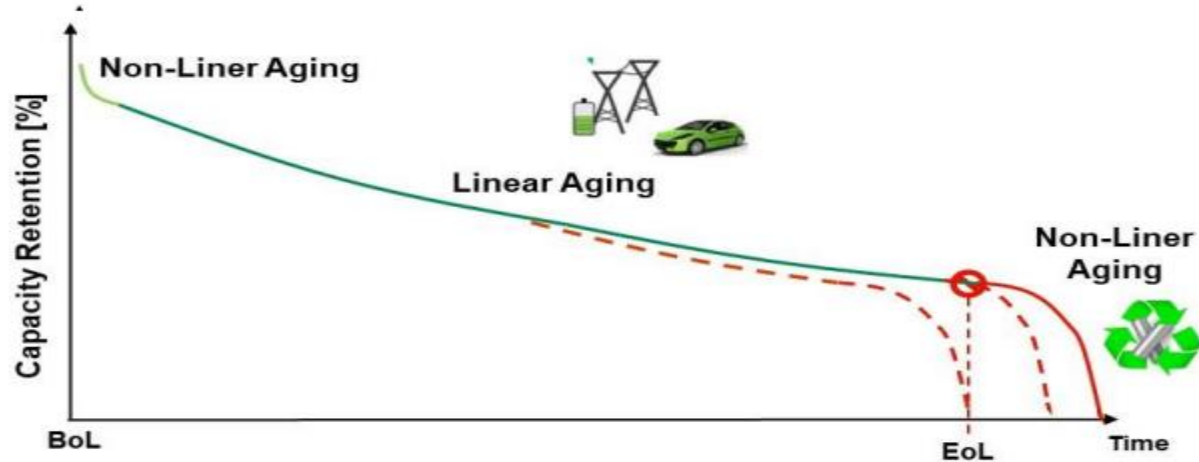
20 BESS Plants
 1.7 GW
 6.8 GWh

Awarded capacity to be ensured
 8760 h/year (full year)



ERCOT Market in Texas (100% merchant basis)

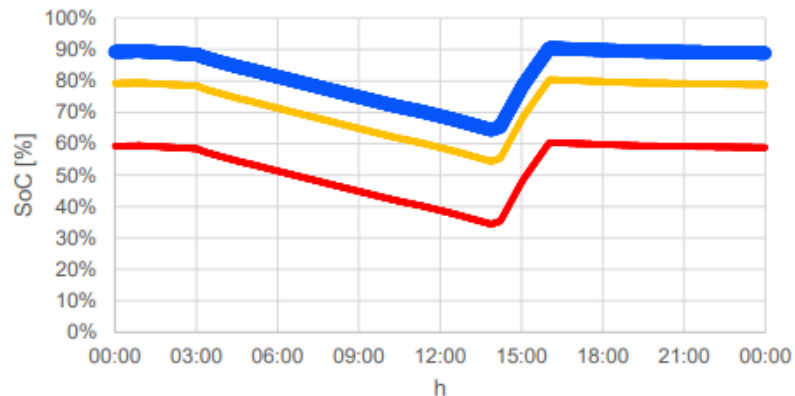
6,6% of YTD Revenues of a BESS plant
 thanks to 3 different operating days



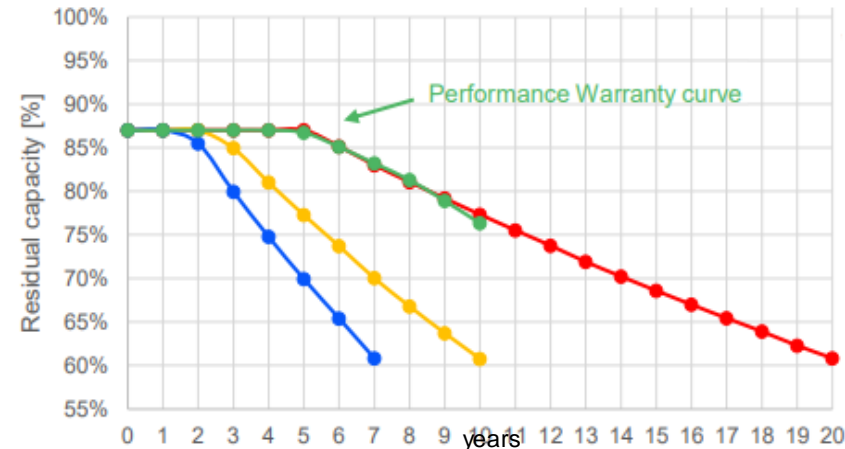
Main Factors affecting degradation

- Age
- State of Charge
- Depth of Discharge

SoC daily profile



— Daily profile 1 —●— daily profile 2 — Daily profile 3



— Daily profile 1 —●— daily profile 2 — Daily profile 3

Optimize the balance between asset performance reduction and bidding strategy is a key point to make the plant healthy as long as possible



Video Lily BESS

<https://www.youtube.com/watch?v=yI3qzvYjMOY> (Lily)



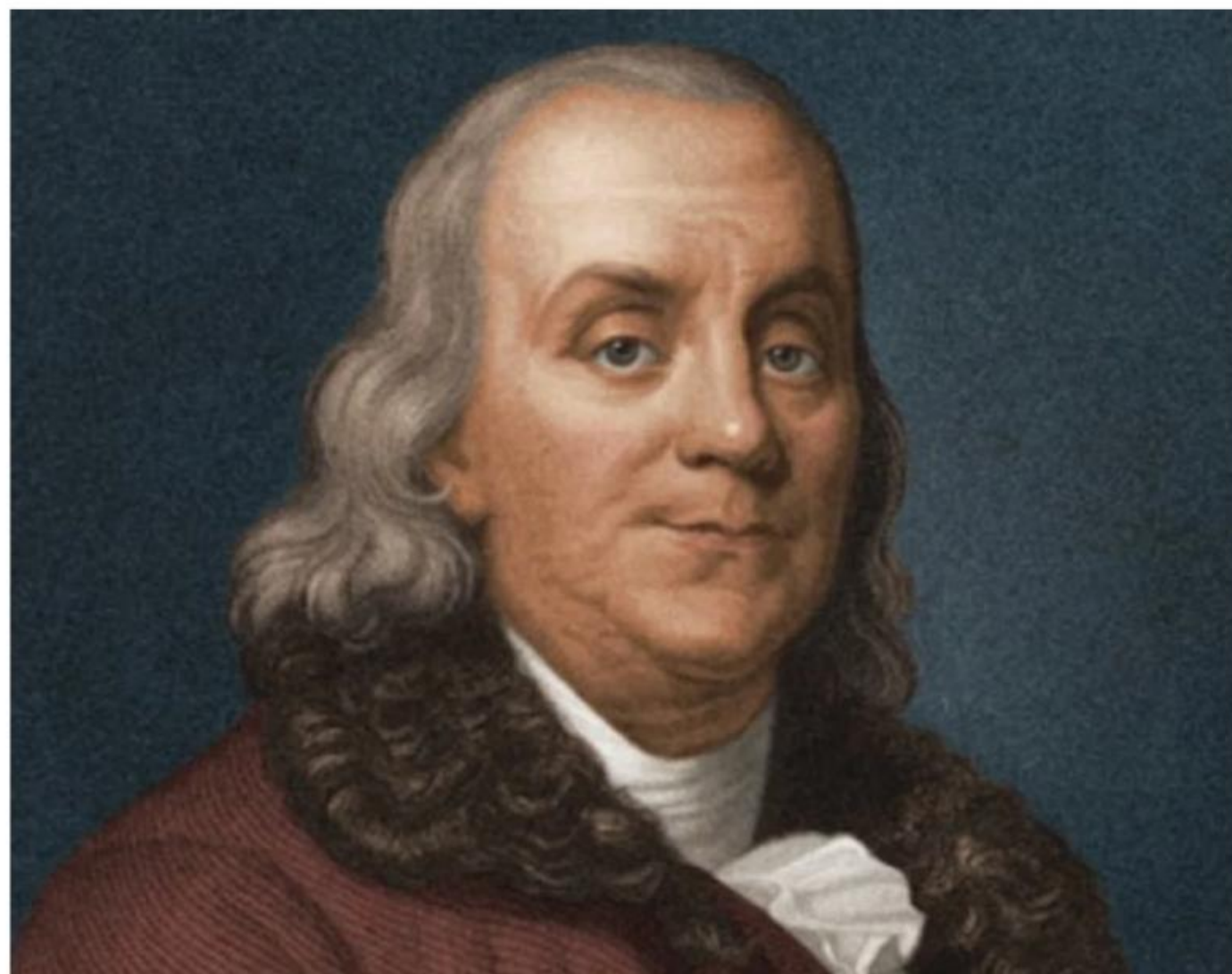
Frequent BESS issues found during Factory Acceptance Testing (FAT)

September 20th 2023

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“The bitterness of poor quality remains long
after the sweetness of low price is forgotten.”
-Benjamin Franklin



AGENDA

- **What is a FAT?**
- **Why is it important?**
- **What kind of defects do we find at factories**

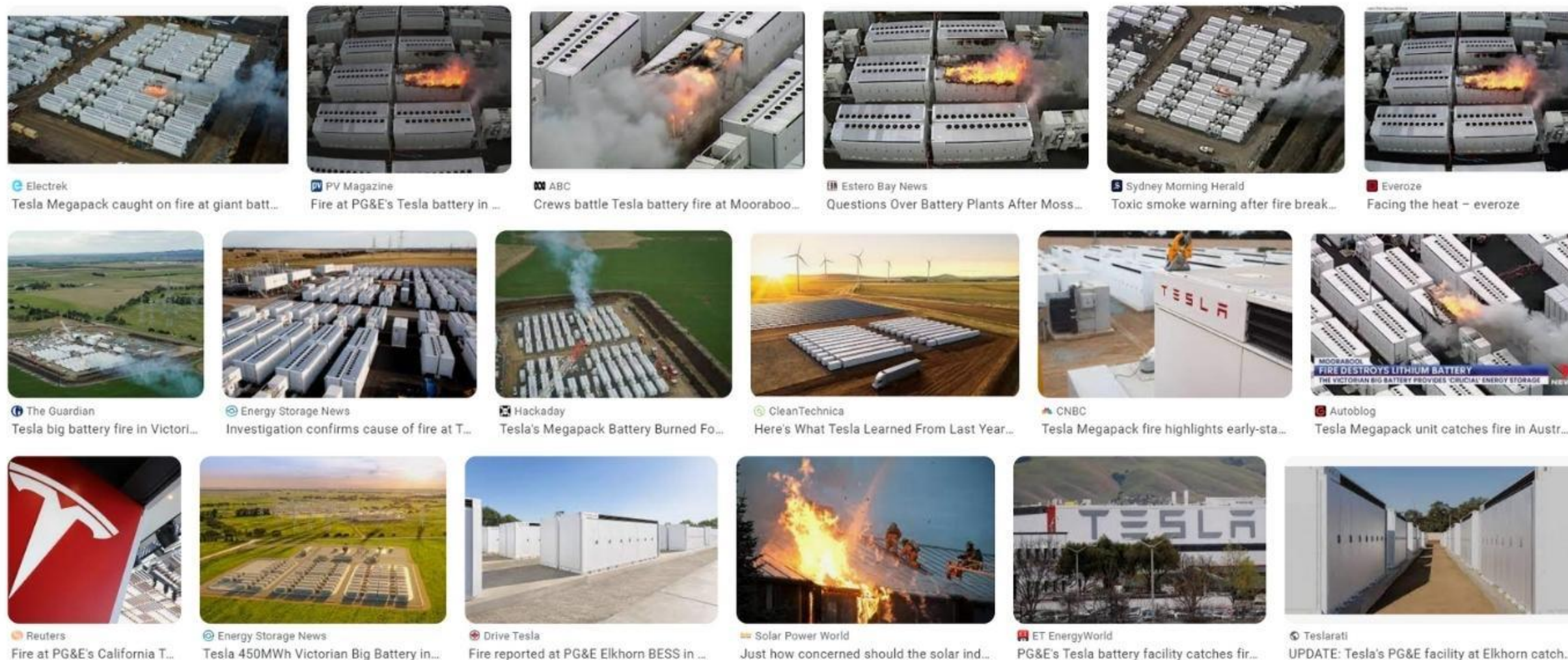


HOW FAT ARE YOU?

- **Factory Acceptance Testing**
- **Battery Energy Storage System (BESS)**
- **Mix of Visual Inspection + Functional Test**
- **Transfer of ownership from supplier to owner**

SINOVOLTAICS: WHY FAT IS IMPORTANT?

→ AVOID THE HEADLINES



Tesla Megapack battery ignites at substation after less than 6 months

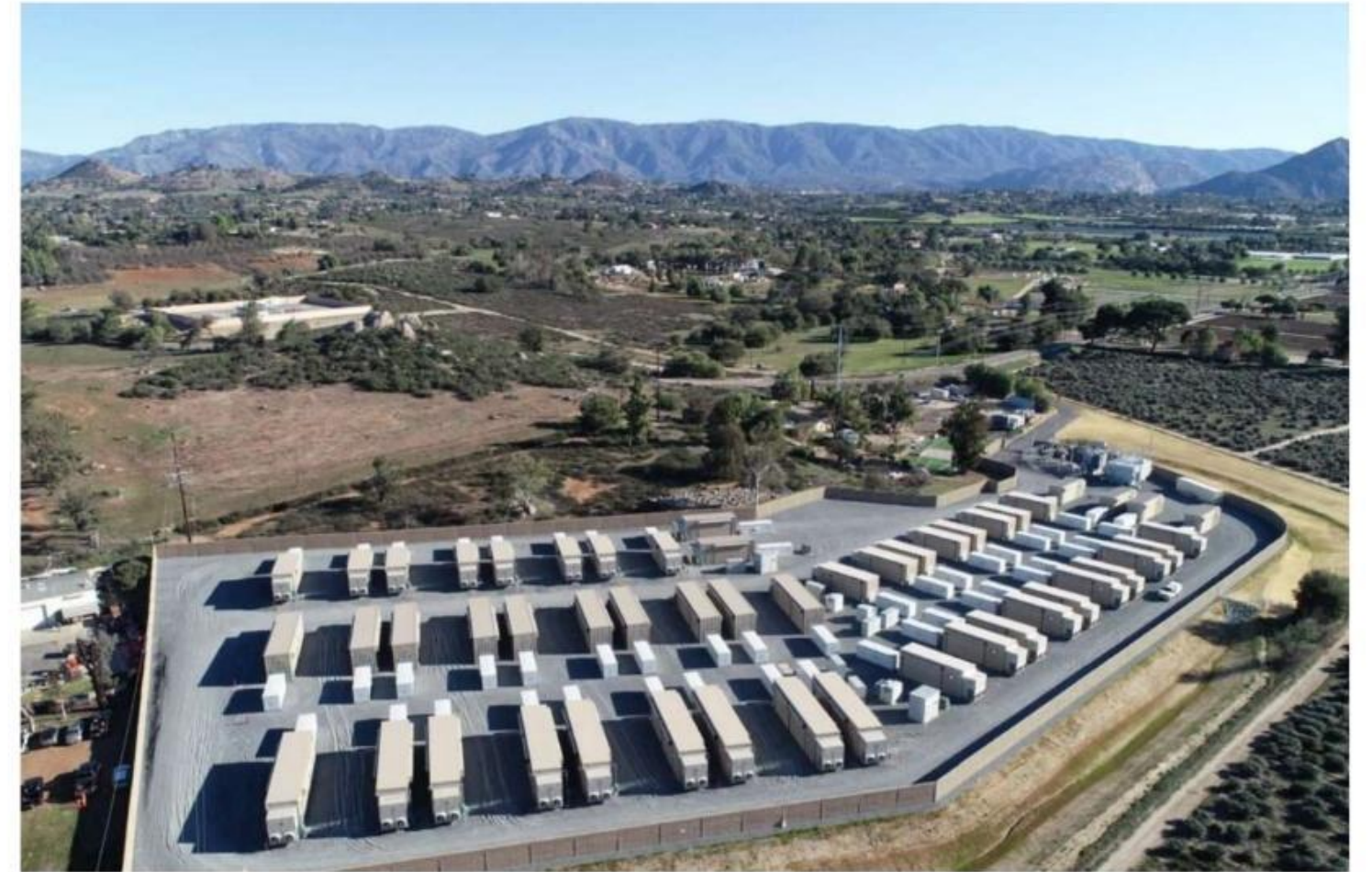
SINOVOLTAICS: WHY FAT IS IMPORTANT?

→ ENSURE YOUR ROI

Terra-Gen: Faulty sprinkler system forced the decommissioning of stolen Valley Center LG batteries

By [Cameron Murray](#)

March 9, 2023



“In response to your inquiry about why the battery packs were decommissioned just one year after the system was energized, in April of 2022, a sensor system fault triggered the water-based protection systems resulting in the batteries in question to be taken out of service.”

SINOVOLTAICS: WHY FAT IS IMPORTANT?

→ LACK OF FAT STANDARD



- No FAT standard
- Standards like UL 9540A are only for design
- Everyone can make its own tests
- Case by case basis
- Supplier want to ship as soon as possible

SINOVOLTAICS TESTS PERFORMED DURING FAT

- Visual Inspection
- Component measurements
- BESS integration
- Performance tests



FREQUENT BESS ISSUE #1

VISUAL INSPECTION DEFECT

It won't impact your
BESS performance,
but....



FREQUENT BESS ISSUE #1

VISUAL INSPECTION DEFECT

Paint Measurements



FREQUENT BESS ISSUE #2

FIRE SAFETY SYSTEM NOT WORKING

Found 1/3 of the time...

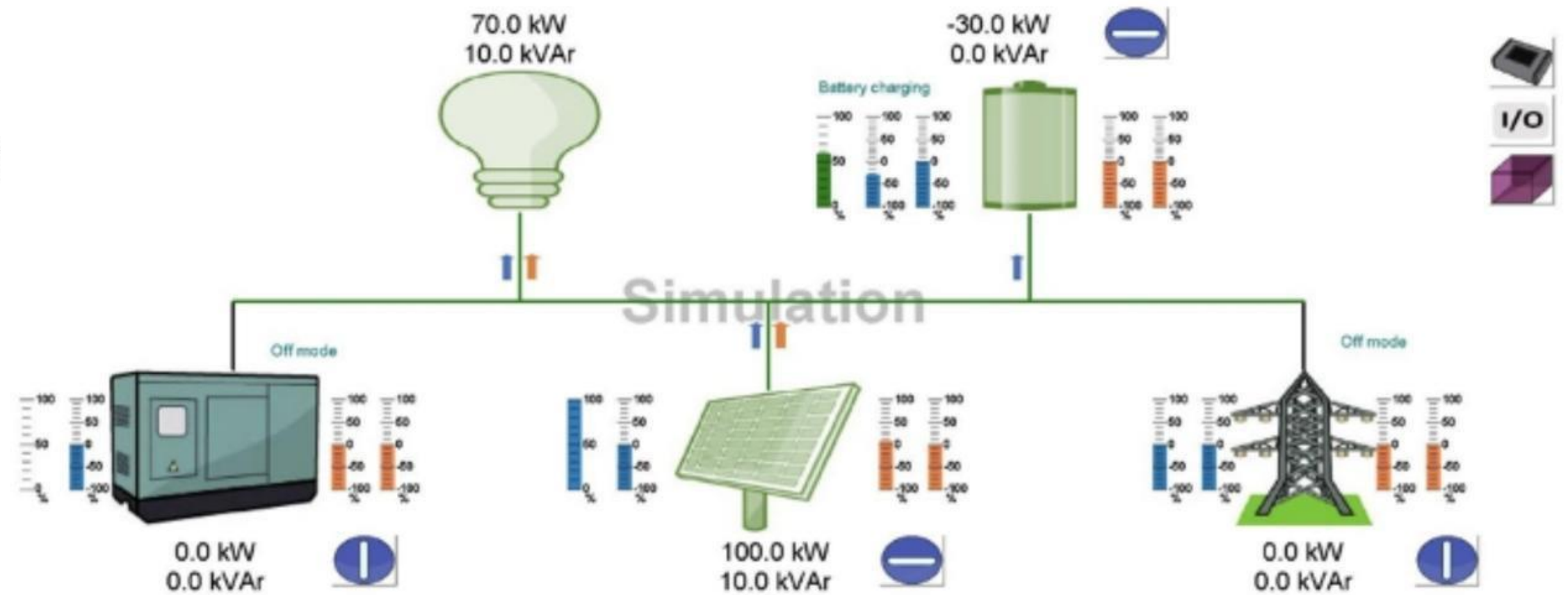


FREQUENT BESS ISSUE #3

BESS SOFTWARE INTEGRATION ISSUE

Confirm the follow systems are well integrated:

- BESS-EMS
- PCS-BMS



FREQUENT BESS ISSUE #3

BESS SOFTWARE INTEGRATION ISSUE

PCS Modbus addresses



0x03	1202 (04B2)	2	U16	floating charge voltage		1000对应100Vdc	HEX	
	1203 (04B3)	2	U16	On grid EOD (high)		1000对应100Vdc	HEX	
	1204 (04B4)	2	U16	off grid EOD (low voltage)		1000对应100Vdc	HEX	
0x03	Lithium battery Settings read							
	1210(04BA)	2	U16	on grid DOD		100对应100%	HEX	
	1211(04BB)	2	U16	off grid DOD		100对应100%	HEX	
	1212(04BC)	2	U16	Charging voltage	[150, 850]	1:1	HEX	
	1213(04BD)	2	U16	Discharge voltage	[150, 850]	1:1	HEX	
	1214(04BE)	2	U16	Charging current limit	[0, 1500]	1:1	HEX	
0x03	BMS Upload Battery Information Read							
	1220(04C4)	2	U16	Battery Total Voltage		0.1V	HEX	
	1221(04C5)	2	S16	Battery Curret		0.1A	HEX	
	1222(04C6)	2	U16	SOC		1%	HEX	V864
	1223(04C7)	2	U16	SOH		1%	HEX	V866
	1224(04C8)	2	U16	Max Single Cell Voltage		1mV	HEX	V918
	1225(04C9)	2	U16	Min Single Cell Voltage		1mV	HEX	V917
	1226(04CA)	2	U16	Max Single Cell Temperature		0.1℃	HEX	V920
	1227(04CB)	2	U16	Min Single Cell Temperature		0.1℃	HEX	V919
	1228(04CC)	2	U16	Charge Current Limit Piont		0.1A	HEX	not sent
	1229(04CD)	2	U16	Disharge Current Limit Piont		0.1A	HEX	not sent
	1230(04CE)	2	U16	Charge Limit Power		1kW	HEX	V867
	1231(04CF)	2	U16	Disharge Limit Power		1kW	HEX	V868
	1232(04D0)	2	U16	Battery Status	U: Normal, I: Forb	1kW	HEX	V921

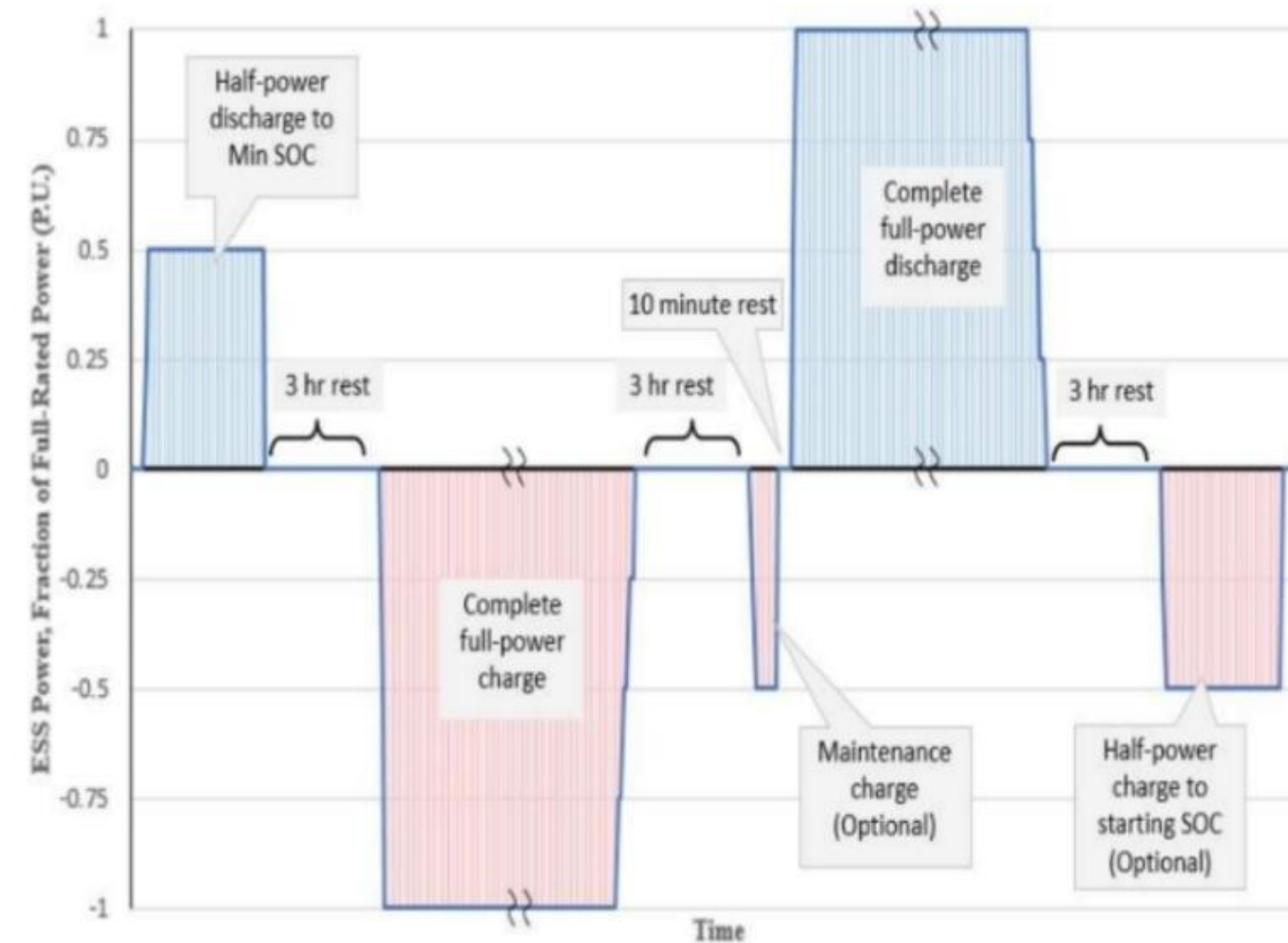
EMS Modbus addresses



FREQUENT BESS ISSUE #4

FAIL BESS PERFORMANCE TEST

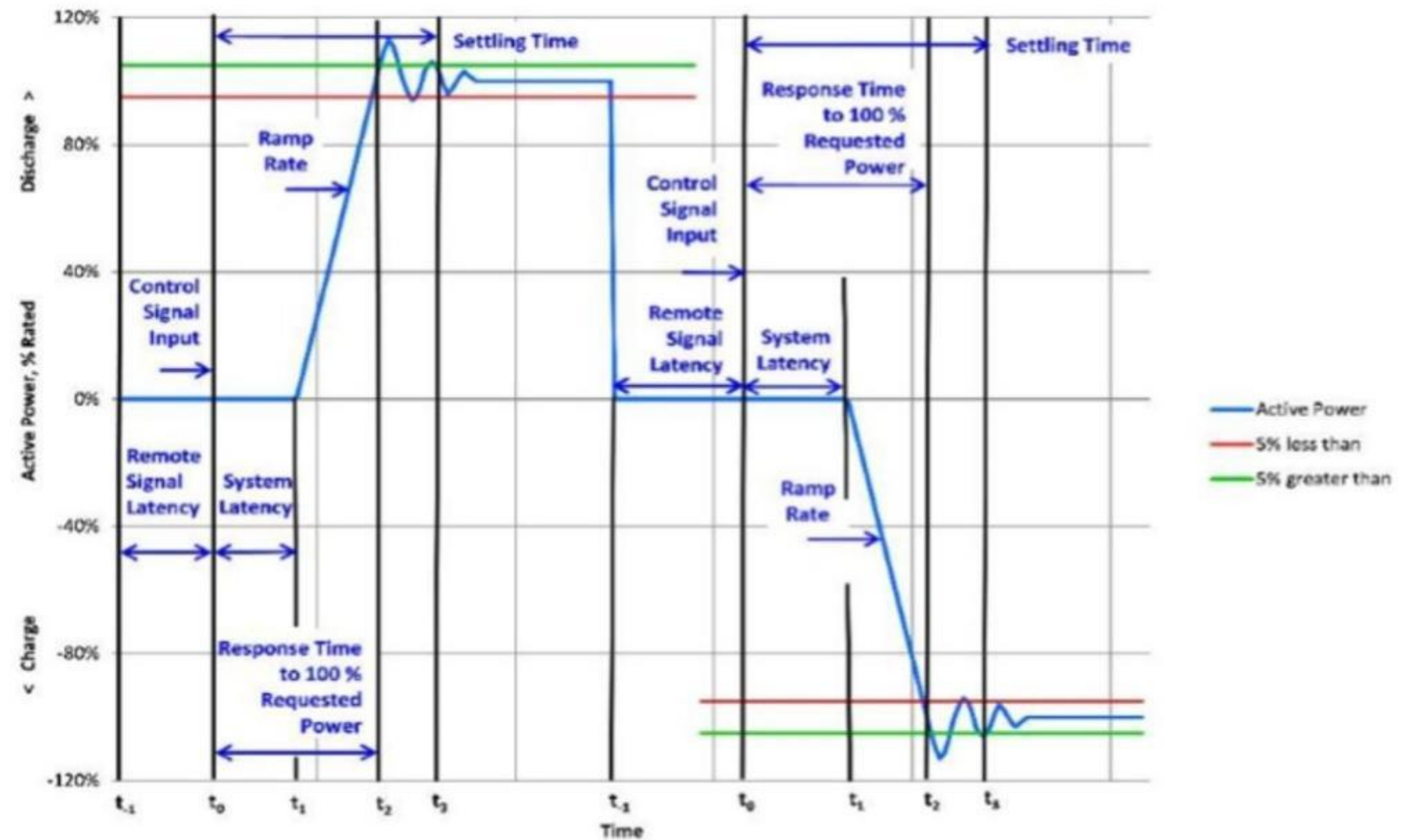
Operation performance
test charging &
discharging profile



FREQUENT BESS ISSUE #4

FAIL BESS PERFORMANCE TEST

Full charge and full discharge response tests profile



CONCLUSION ABOUT BESS FAT

- Align on the BESS tests to be performed
- Have someone on site to confirm the FAT results
- Ensure the BESS integration test (if any) are scheduled ahead
- Tests your BESS at maximum power/specifications



“The bitterness of poor quality remains long after the sweetness of low price is forgotten.”
-Benjamin Franklin

CERTIFICATION AND ACCREDITATION



Solar
Best
Practices



CQI



IRCA

SINOVOLTAICS TRACK RECORD



10+ YEARS

At the PV and BESS
Factories in Asia



17.6+ GW

ZERO RISK SOLAR®
Projects



14,800+

Community



250+

PV & BESS Factories
Audited

CONTACT OR VISIT US

USA office

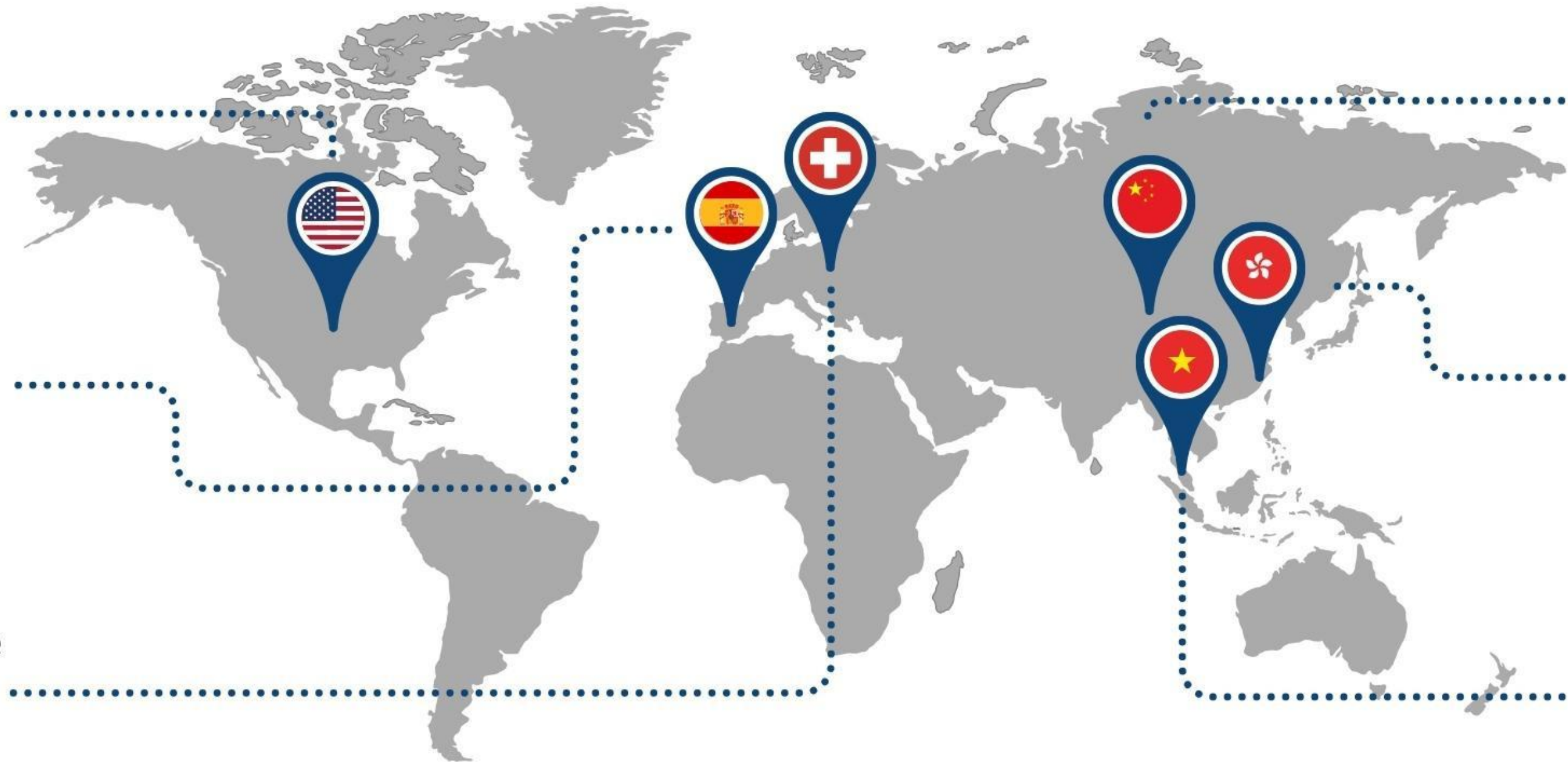
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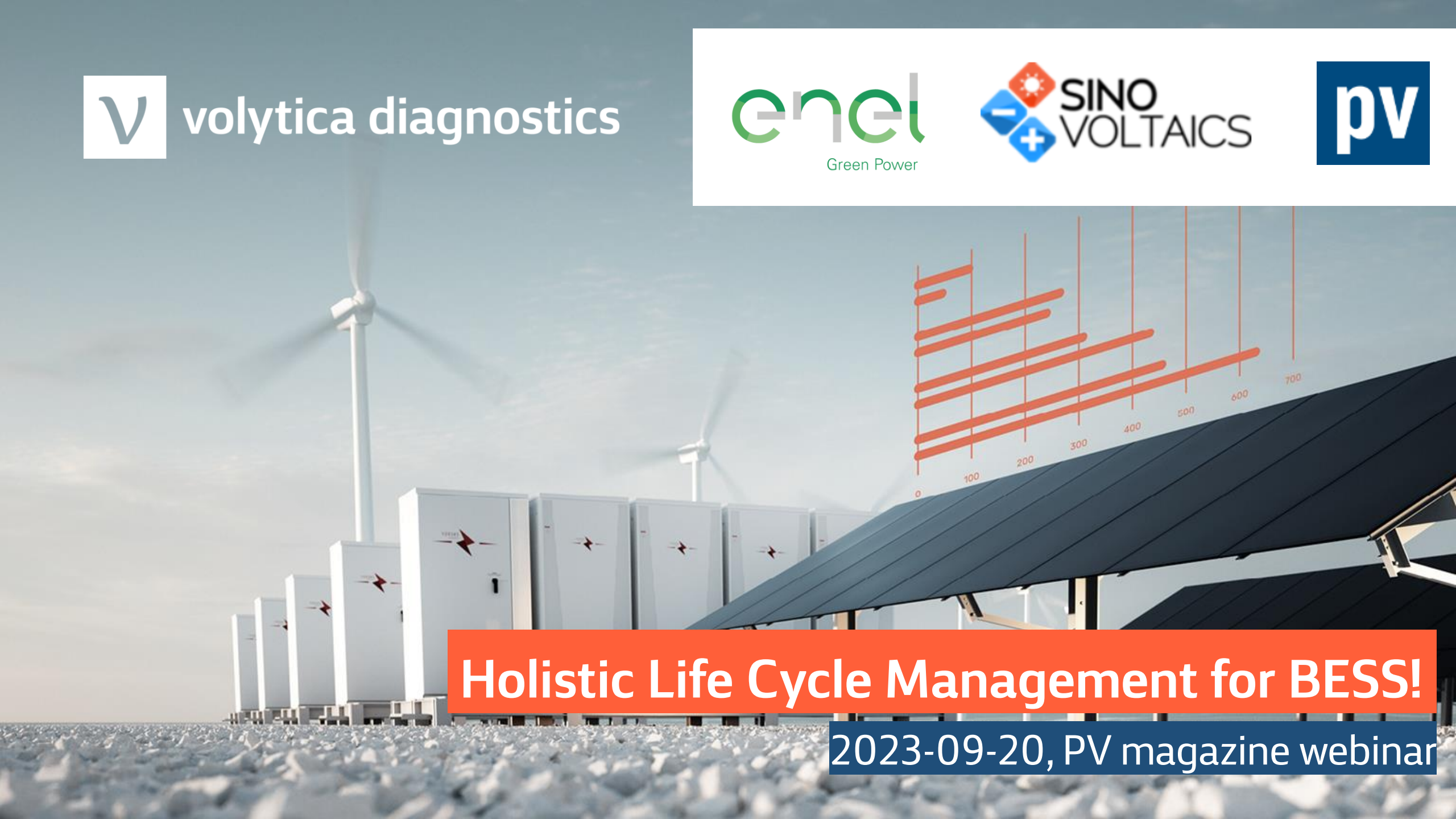
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Holistic Life Cycle Management for BESS!

2023-09-20, PV magazine webinar



volytica diagnostics

A Brief Introduction



We have more than 10 years of practical experience with applied battery diagnostics across industries

2012

First European E-Busses Monitored

volytica's predecessor research group at Fraunhofer monitored some of the first e-busses in Europe ([link](#), [link](#))



2017

Launch of First Battery Monitoring Platform

IVImon, the first version of today's *vdX engine*, is launched into pre-commercial operation by Fraunhofer IVI

2019

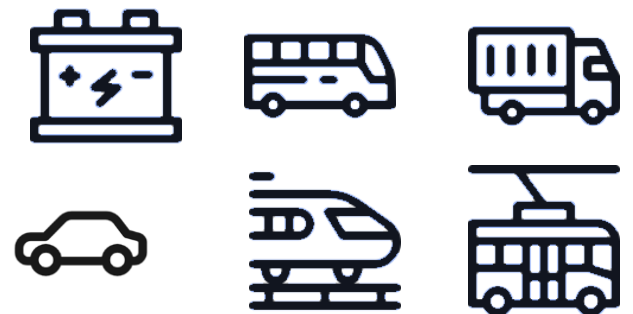
Spinoff from the Fraunhofer Gesellschaft

For further growth and industrialization, volytica is spun out of Fraunhofer Society as a independent company

2023

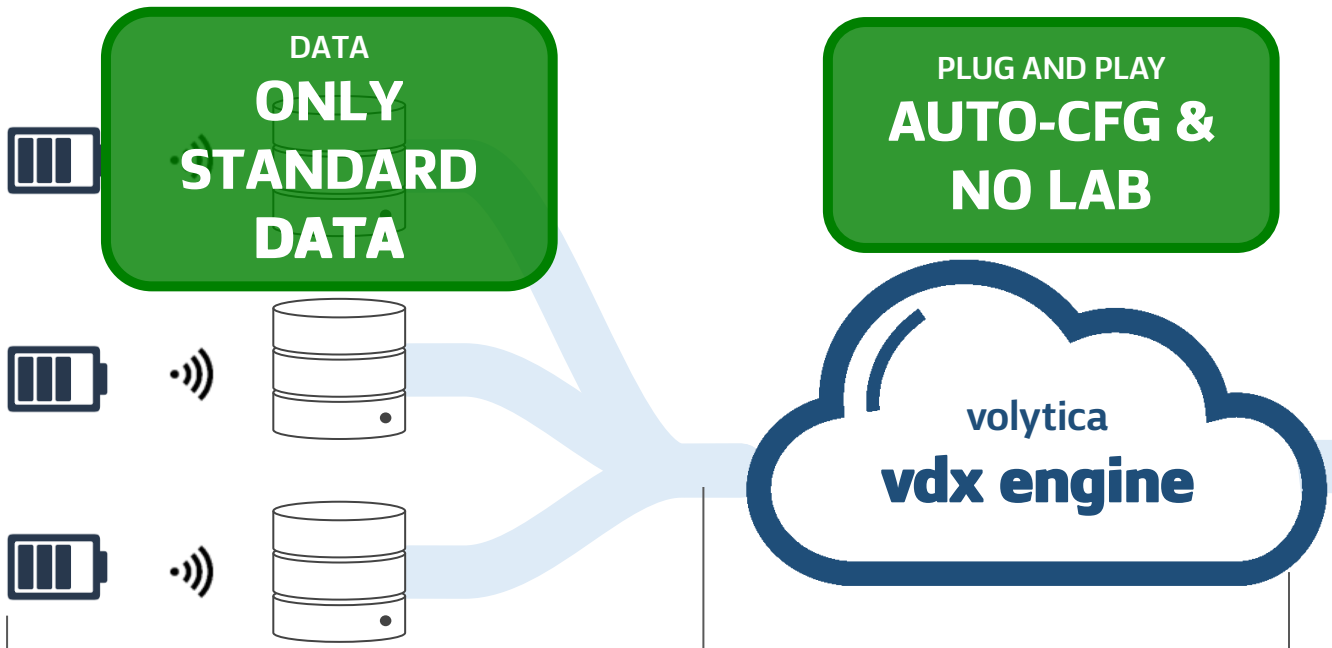
One of Europe's leading battery diagnostics companies

With more than 25 experts in Dresden and Berlin, as well as >10 international customers in the commercial & stationary industry



Our Solution

We crack abundant data that others discard, using our proprietary battery algorithms



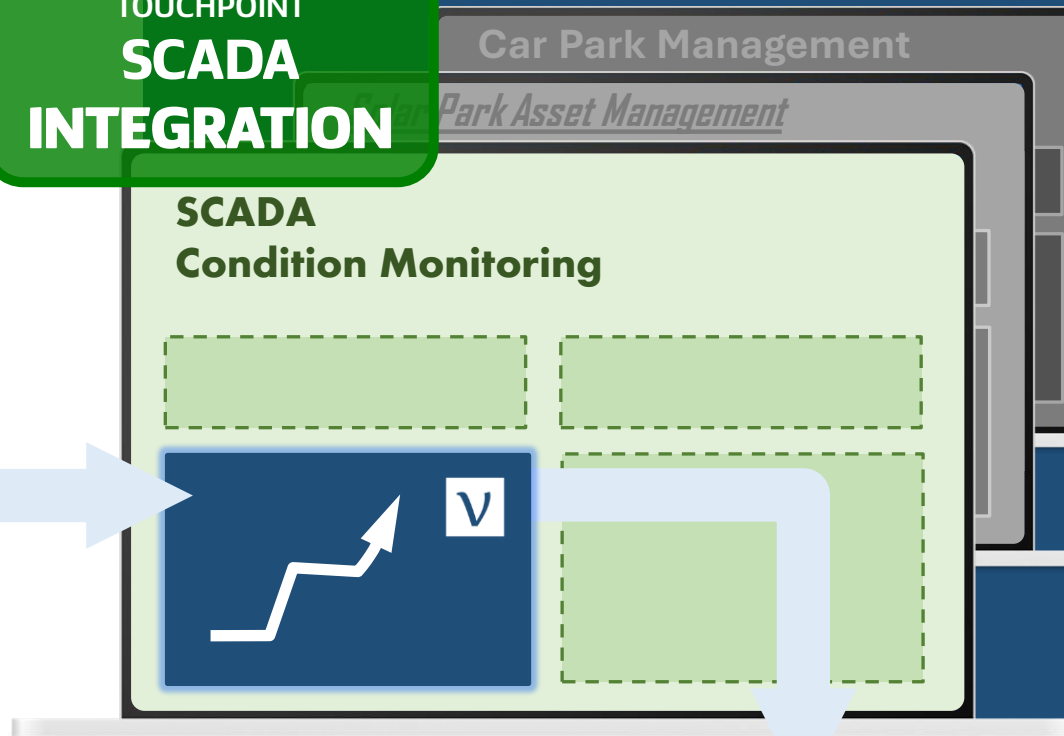
No Hardware
Every Li-Ion battery is supported

Existing Data
All commercial batteries transmit and store the relevant signals

Plug-and-Play
Our algorithms are self-learning. We don't need the typical 6 months lab tests.

Quick to Start
Cloud-based analysis tool for systematical battery quality analysis
Fraunhofer inside

TOUCHPOINT SCADA INTEGRATION

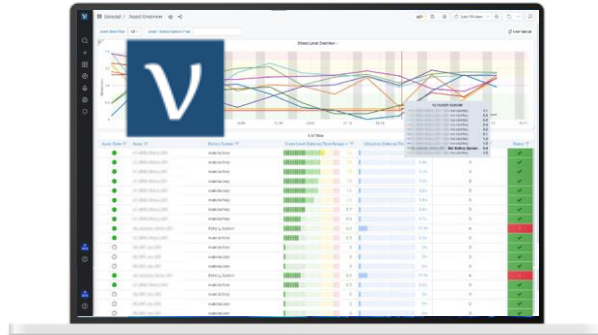
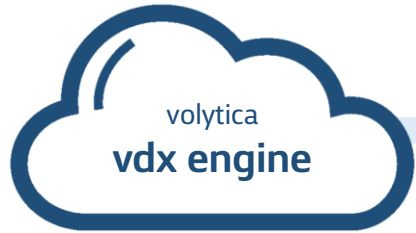


- Utilization & profit optimization
- Lifetime extension & maintenance planning
- Residual value & 2nd life certification
- Safety & anomaly detection

INNOVATIVE FEATURE SCOPE



Get it from us.
Or get it from your SCADA provider.



Get it from volytica

- All battery analytics in one spot
- Web dashboards and degradation reports
- Start immediately, minimal integration effort

... or from your SCADA provider!

- Integration of battery analytics & optimization into existing SCADA and condition monitoring systems
- Maximum user friendliness
- Check with your provider for compatibility



Key Messages

Batteries are **complex black boxes**

Transparency enables optimal usage of your investment

For transparency, **you need a tool**

For optimal performance of your tools, **you need data**



Introduction to Battery Technology

Key Facts & Common Misconception



SUNGROW

No.1

THE WORLD'S MOST
No.1 bankable for 4 con
The only inverter suppli

RE100 EP100

The Battery Cycle part two: Device lifespan

Having discussed battery chemistry in a previous article, Volytica diagnostics here examines the causes of battery degradation and how to extend device lifetimes, ahead of a **pv magazine** webinar tomorrow.

SEPTEMBER 19, 2023 **CLAUDIUS JEHL**

DISTRIBUTED STORAGE

ELECTRIC VEHICLES

ENERGY STORAGE

OPINION & ANALYSIS

WORLD



“The Battery Cycle”

Difficult topics in easy language

Chemistry, charging, SOH, safety, ...

PODCAST in the making!

Battery Basics

The “Zoo”



Li Ion

NMC-like

Nickel Manganese Cobalt

- family of Ni-based cathodes (related to NCA, LMO, ...)
- so far, “the” automotive standard
- higher energy densities (increasing)
- mediocre lifetime, **decreasing!!**
- higher prices

Trend

Lifetime *Decreases*

LFP

Lithium Iron Phosphate

- also LiFePO_4
- “the” standard cell in China, increasing global relevance
- lower energy densities (increasing)
- better lifetime, ‘robust’
- lower prices (**increasing!!**)

Trend

“LFP Renaissance”

Others

more exotic versions

- several other “exotics” chemistries exist or are in pipeline
 - LTO / Titanate
 - Solid State
 - Li-Air, Li-Sulfur, ...
 - (Na Ion ... not Li)

Trend

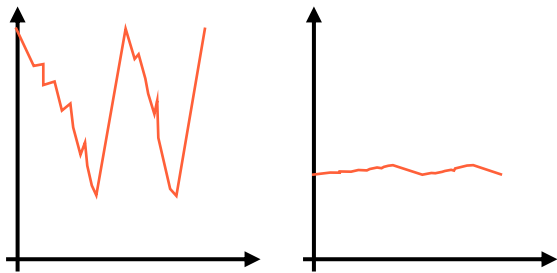
Solid State? Wait for it



Battery Basics

Batteries are Wearing Parts

“Mission Profile”



- Operation & Charging**
- 🔑 Temperature
 - ⚡ Power
 - 📊 SOC window

- Standing/ Parking**
- 🔑 Temperature
 - 📊 parking SOC



Capacity Fade
Energy decreases

Resistance Increase
Efficiency decreases

Availability & Safety
Risks increase

The Mission Profile significantly influences *determines* degradation rate and safety risks



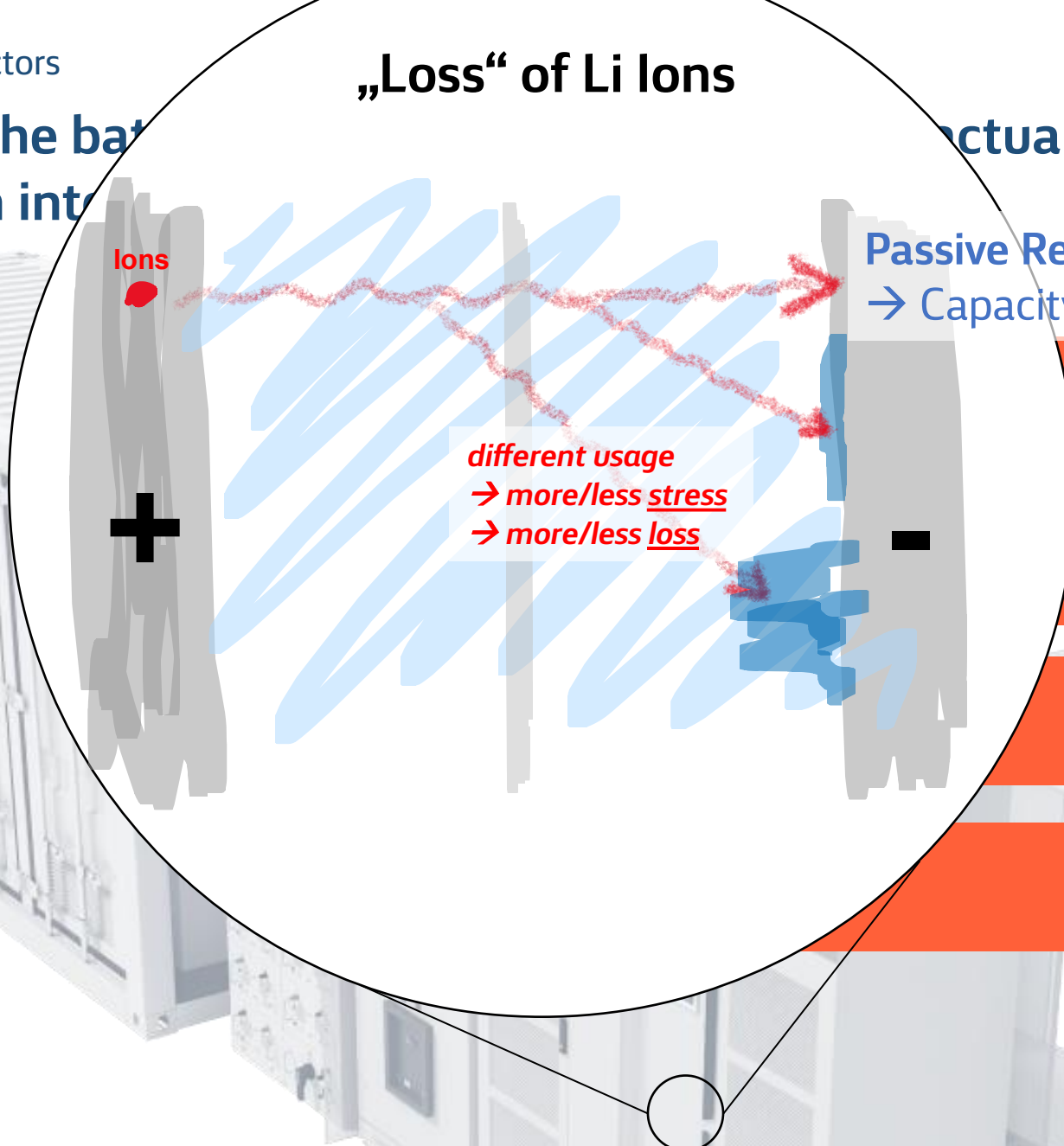
Performance Degradation

Availability & Safety

When the battery happens internally

„Loss“ of Li Ions

actually



Passive Residue („SEI“)
→ Capacity Fade

different usage
→ *more/less stress*
→ *more/less loss*

Multiple internal processes lead to degradation

Li ions react with internal chemicals (e.g. electrolyte)

Like all chemical reactions, their intensity depends on circumstances

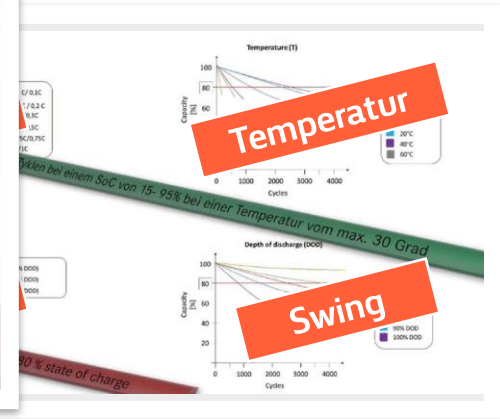
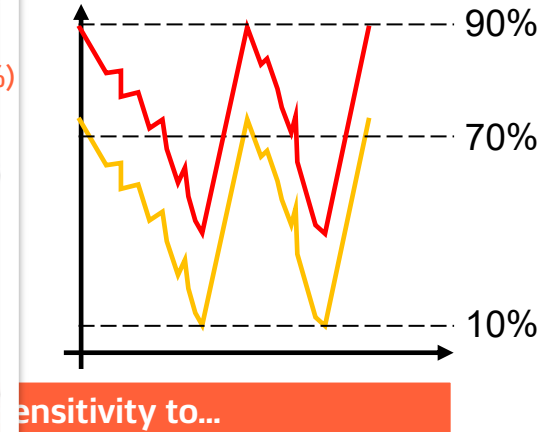
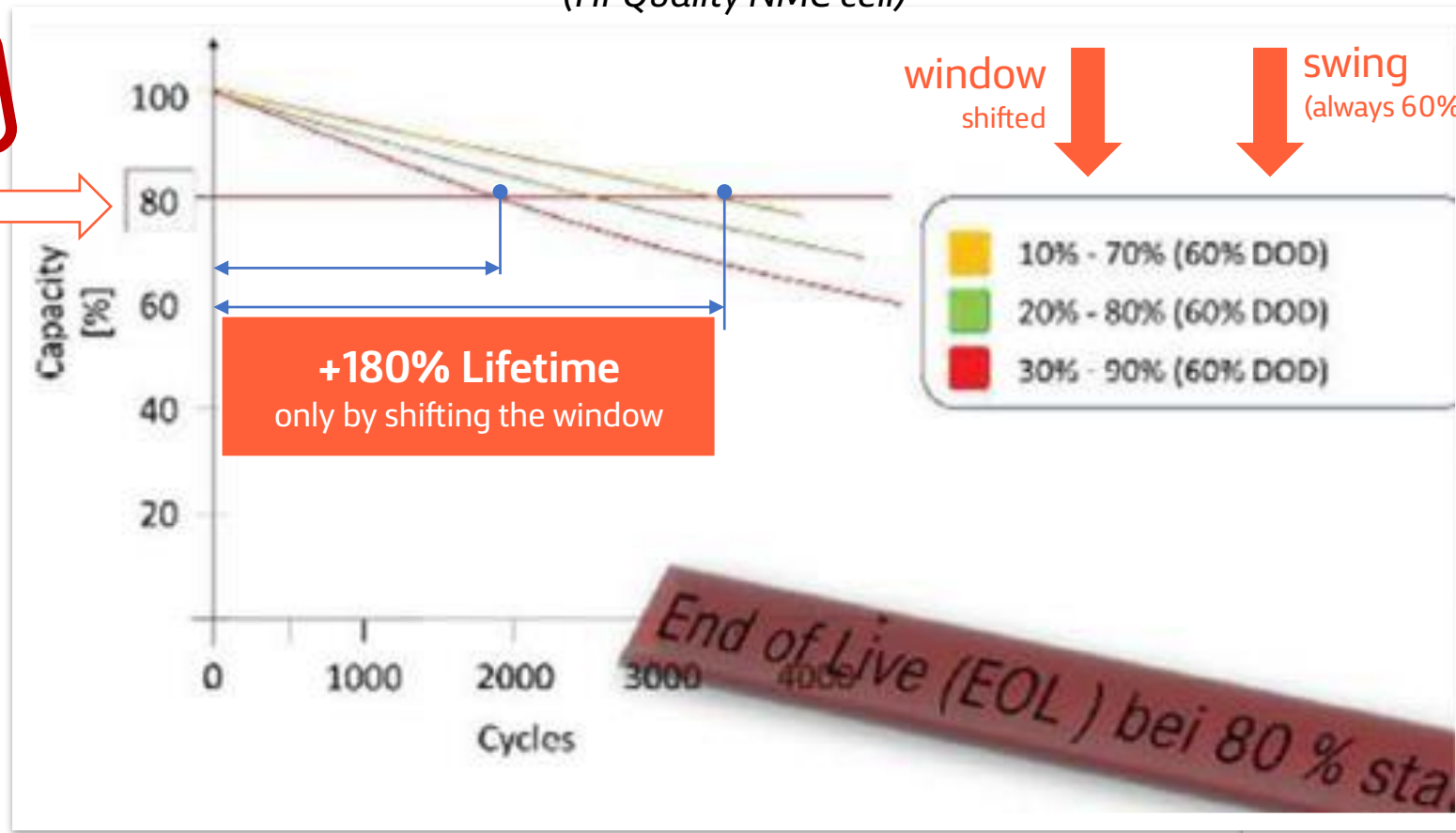
The mechanics are quite... complex → see next slides



Degradation & Warranty

Degradation: Capacity Fade

From a Vehicle Data Sheet
(Hi-Quality NMC cell)



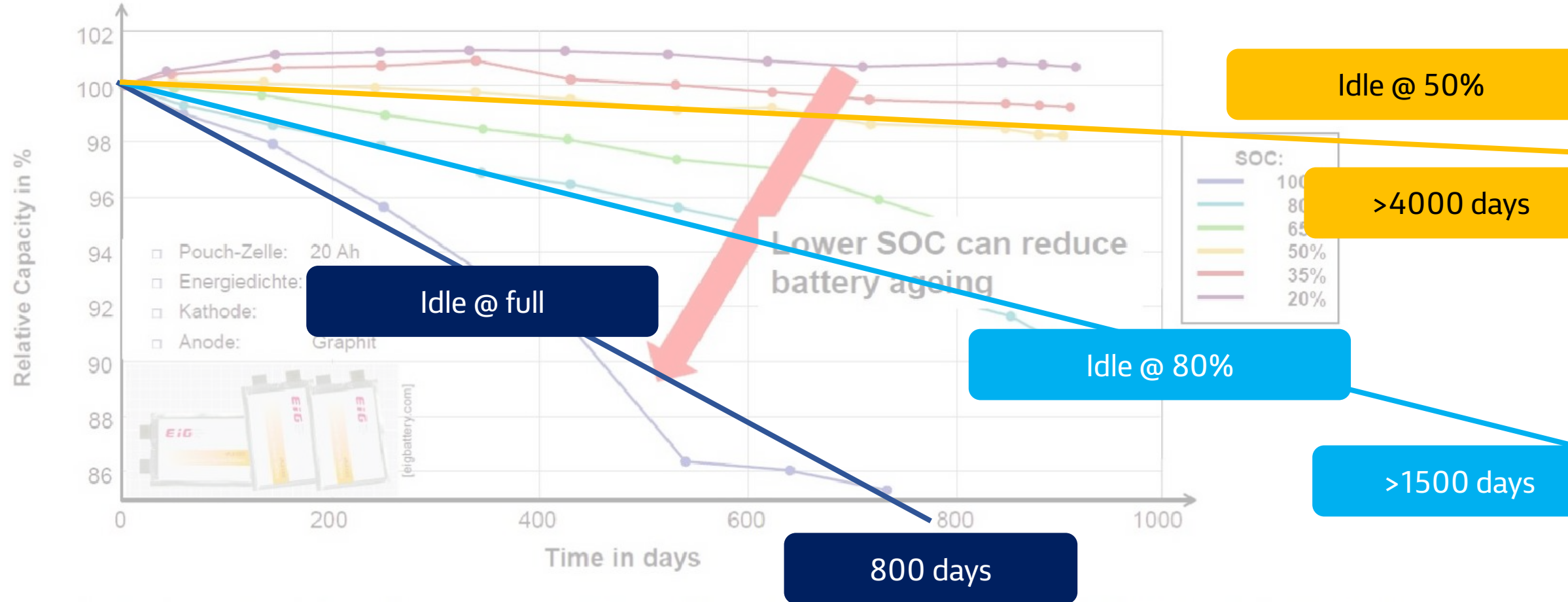
Depending on Chemistry, the Expectable Lifetime is drastically influenced by 4+2 external factors
That often allows for interesting lifetime optimization potentials

Degradation & Warranty

Degradation: Capacity Fade



IDLE SOC





Degradation Determination & Forecasting

Continuous Analysis of all relevant KPIs

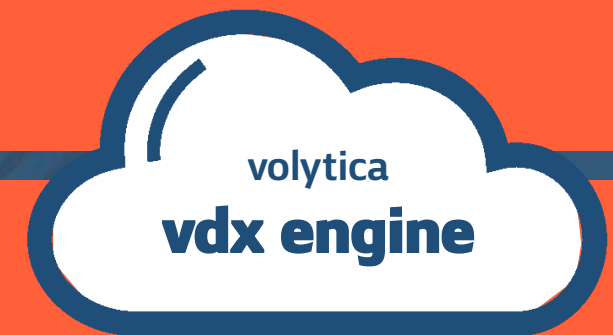
- Stress Level
- Energy Capacity
- Charge Capacity
- Efficiencies

Independent of Manufacturer Electronics

- BMS is often inaccurate
- BMS can not track all KPIs

Recommendations

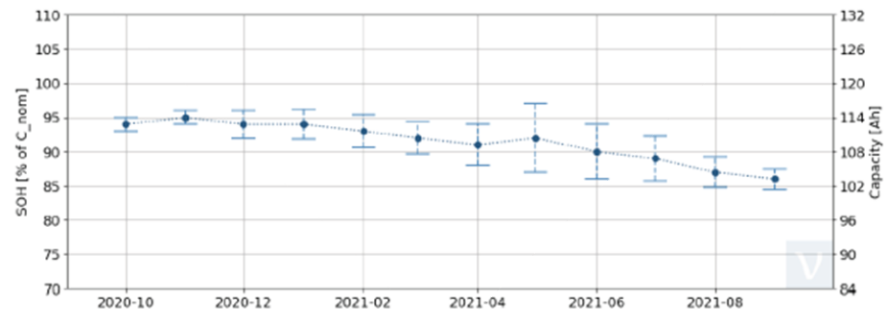
- How to reduce stress
- How to extend lifetime
- How to increase residual value





Degradation Determination & Forecasting

Short-Term Operational Fitness | Long-Term Operational Fitness



Capacity				
	First month	Trend Linear fit over data	Last month	
Algo To Data Fit	good ●●●			
Remaining Capacity <small>Estimation of max. extractable remaining capacity under standard conditions, on system level</small>	94.0% ±0.0%	-9.2 %/yr -16.6 %/kFCE	86.0% ±0.0%	
Cell Capacity Fade <small>Estimation of irreversible capacity spread within the system, based on cell-inhomogeneity analysis</small>	not evaluated		spread max-min	
	not evaluated		asymmetry	

Short-Term Operational Fitness | Long-Term Operational Fitness

Influencing Factors and their Impact on Stress Level

Current avg. Stress Level (SL_{Ref}) = 0.6

Scenario Description	Stress Level Reduction
1. Within Temperature Limits <small>Battery Temperature between 10 °C and 40 °C</small>	-
2. Controlled Battery Temperature <small>Constant Battery Temperature = 25 °C</small>	< 5%
3. Controlled Battery Temperature during Charging <small>Constant Battery Temperature = 25 °C, during charging</small>	< 5%
4. Decreased Idle SOC I <small>max. SOC = 80%, during long idle phases</small>	> 5%
5. Decreased Idle SOC II <small>max. SOC = 50%, during long idle phases</small>	> 10%
6. Downshift SOC <small>Downshift SOC by 10%</small>	not applicable
7. Scenario 2 & 5 Combined <small>Constant Battery Temperature = 25°C & max. SOC = 50%, during long idle phases</small>	> 10%
8. Scenario 1 & 6 Combined <small>Battery Temperature between 10 °C and 40 °C & Downshift SOC by 10%</small>	not applicable

Annotation

- The calculated stress level reduction is based on vdx stressmaps.
- An increase of SL means higher degradation rate. A decrease of SL means lower degradation rate.
- The accuracy of the shown values depends on the quality of the input data and the fit to the stressmap.
- A combination of scenarios does not result in a summed up stresslevel. The correlation is not linear.



Performance Degradation

Availability & Safety

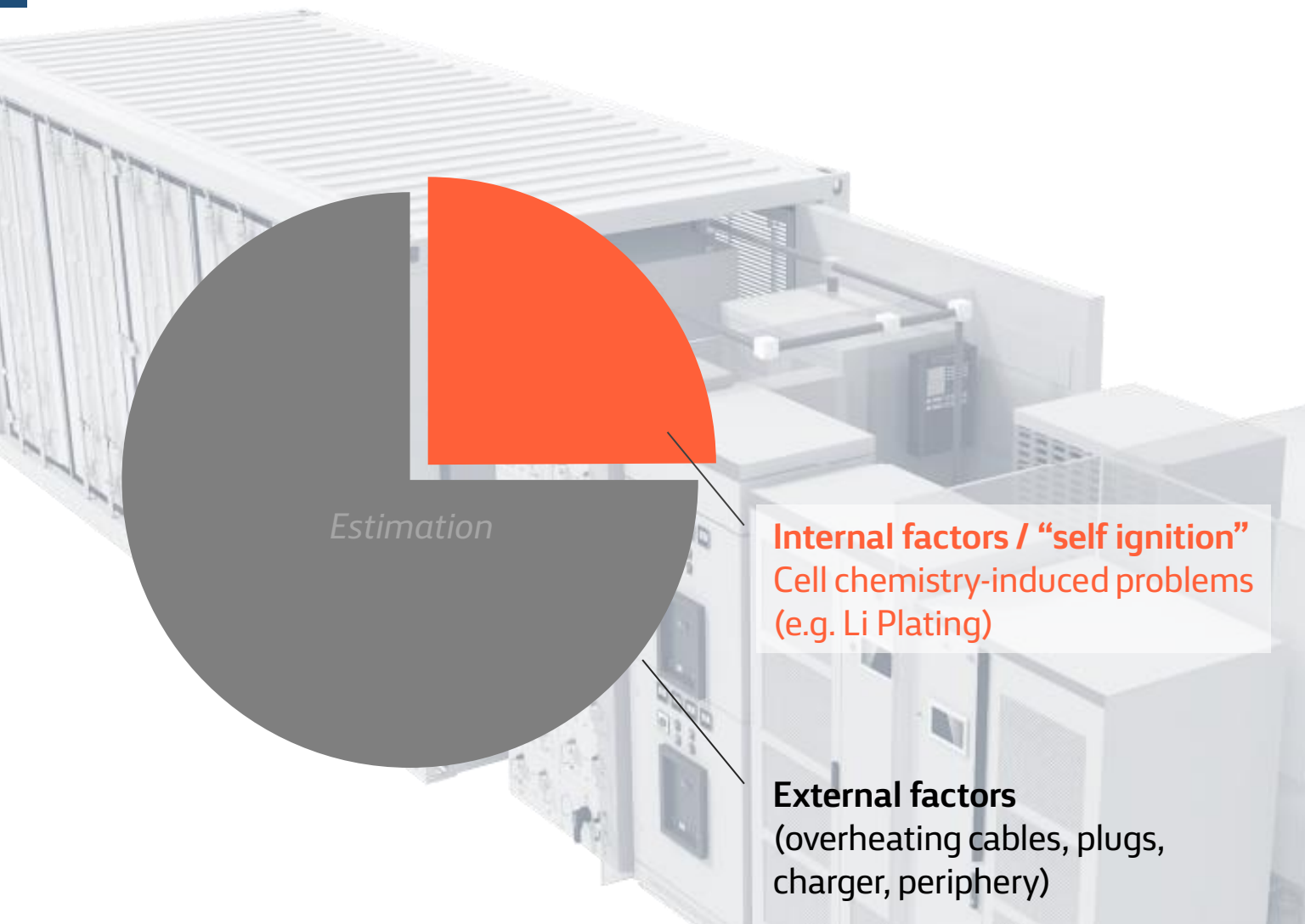


“How did you go bankrupt?”
Two ways. Gradually, then suddenly.”

– Ernest Hemingway, *The Sun Also Rises*

** I stole it, but I forgot from whom – sorry, but thanks for that genius quote.*

Why do batteries actually burn? Well, we don't really know...



Estimation

Internal factors / “self ignition”
Cell chemistry-induced problems
(e.g. Li Plating)

External factors
(overheating cables, plugs,
charger, periphery)



In the EU, at least 100 electric buses,
worth >€50m, burnt down in the last 2 years.

This Stuttgart depot burnt down entirely due
to a faulty electric bus in 2021: >€100m damage



volytica diagnostics 

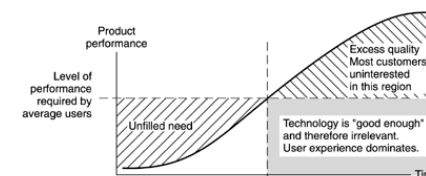
Sustainable Bus Magazine, Feb 2022

Fire Risk & Safety – An Experts Plea

Claudius Jehle, volytica diagnostics GmbH; Prof. Paul Christensen, Professor of Pure & Applied Electrochemistry at Newcastle University; Paul Markham, PM Risk Consultants Ltd.; Alex Johns, Altellium Insurances Ltd.

A Historical Example

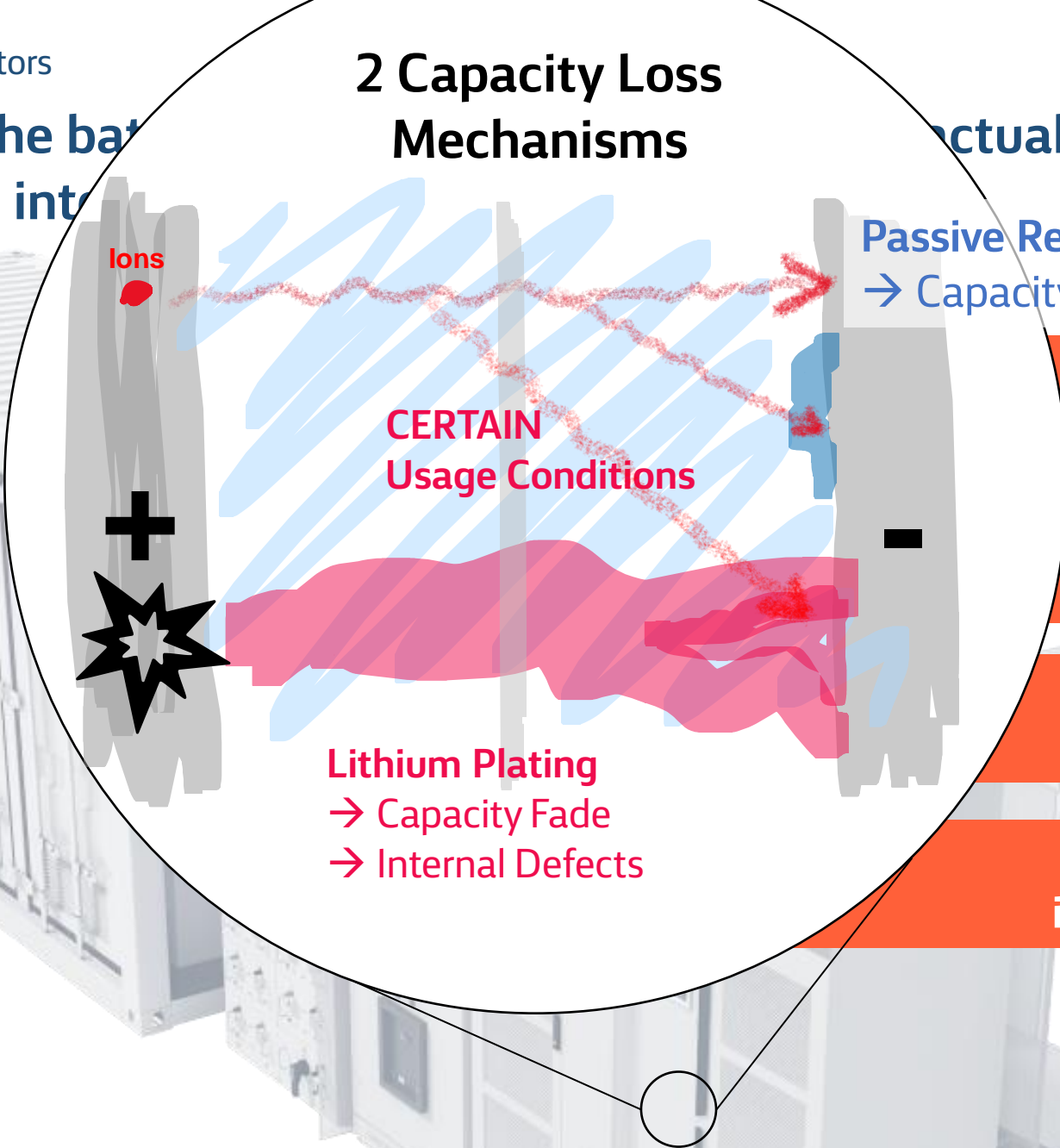
The 1950s through 1980s saw a drive towards increasing the energy density and size of steam turbines from c. 150MW to 600MW – and incidents judged to have been capable of generating 'missiles' at that time are well recorded'. It is apparent from the failure data that there were a number of shortcomings with each of the early designs, particularly with the introduction of the large 500 MW and 660 MW units. But, as in every developing industry, each development is likely to go through, and undergo at times a painful cycle of continuous learning and improvement.



When the battery happens internally

2 Capacity Loss Mechanisms

Actually



Multiple internal processes lead to degradation

Not all of them are dangerous – but Plating is!

Li Plating is usage-induced. It's hard to completely avoid!

Certain long-term trends can indicate impending anomalies – if you look!



Some facts and figures on battery safety and failures from around the world.

2%

approx. 2% of all Korean BESS systems encountered fire issues between 2017-22

€750m

this caused an economical impact of up to €750m total losses

-50%

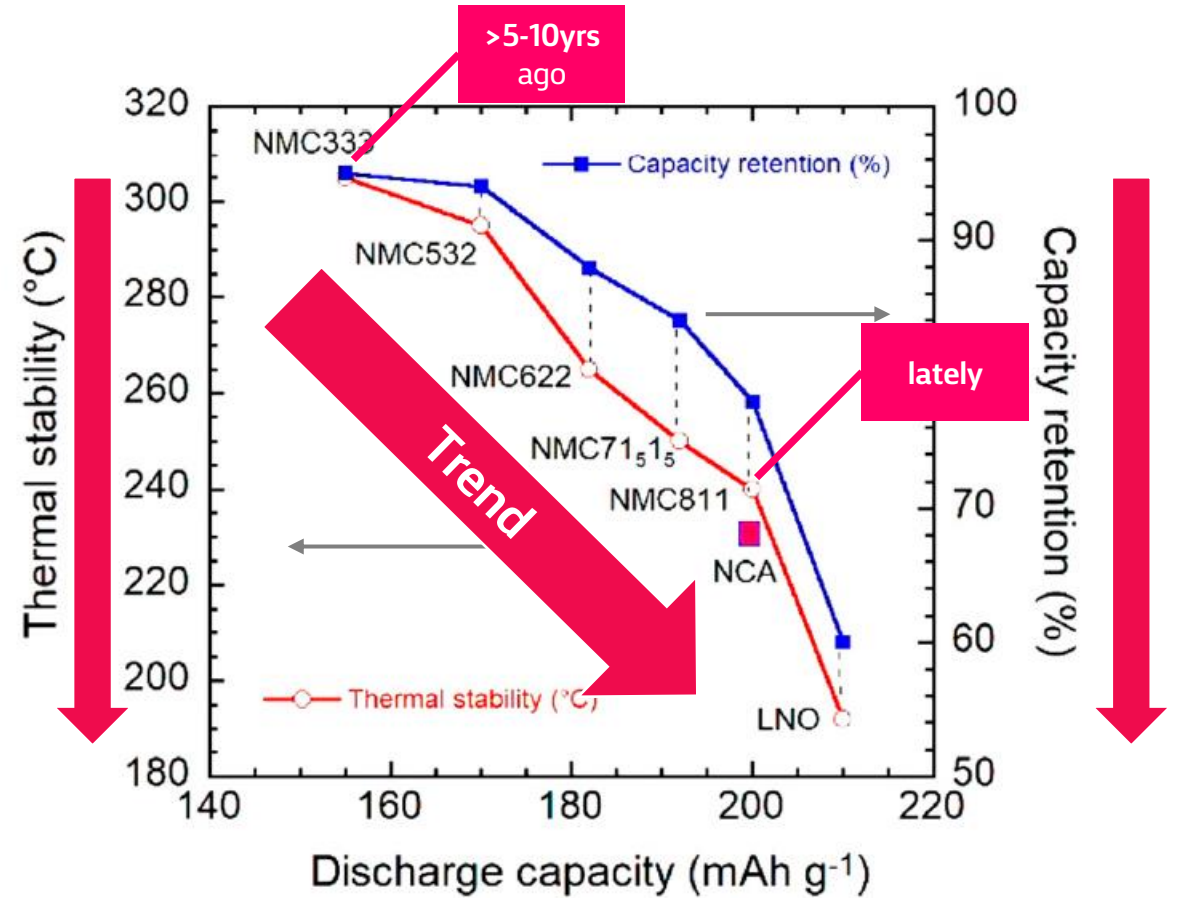
safety margins of automotive-grade NMC batteries decreased in the last years!

~90%

of all events could be have been detected beforehand, Korean study estimates

LFP

...is *harder* to ignite, but once on fire, can burn more violently than NMC, studies say



NCA, NCM811, and the Route to Ni-Richer Lithium-Ion Batteries
Christian M. Julien * and Alain Mauger
10 October 2020; Accepted: 30 November 2020; Published: 2 December 2020;
Energies 2020, 13, 6363; doi:10.3390/en13236363



Click to learn more!



Anomaly & Safety Detection Algorithms

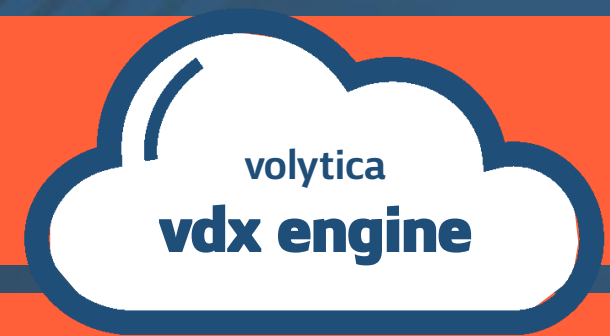
Continuous Analysis of several safety & anomaly-critical KPIs

- Thermal Anomalies
- Balancing / symmetry anomalies
- Cell quality / safety anomalies

Alerting on trends and abnormal behaviour

- All KPIs are continuously analysed for trends
- Short- and long-term anomalies are sent via mail
- Mitigation recommendations

Training of personnel





Anomaly & Safety Detection Algorithms

Anomaly Indicators

General / Event Logbook

Include Subelements: all children ▾

Aspects / Sources: All ▾

Severity: All ▾

Freetext Filter: sym

← back to Subsystem Explorer

Demo BESS Plant

Hierarchy

└ Demo BESS Plant

Subsystems

- Container 1
- Container 2
- Container 3
- Container 4

Severity	Count
Critical	0
Information	0
Warning	48

▼ Chronologically (Demo BESS Plant incl. all children)

Event Time ↓	Relative Time	Severity	Source	Event Name	Event Description	Link
2023-01-27 01:59:59	vor 6 Monaten	⚠ Warning	vdx-peer-group-alerts	[peer_cap-symmetry_daily]	C04 B01 Rack 05: Capacity symmetry differs significantly from peers. Check m...	➔
2023-01-27 01:59:59	vor 6 Monaten	⚠ Warning	vdx-symmetry-alerts	[thermal_symmetry_longterm_anoma...	C04 B01 Rack 03: Slow thermal asymmetry trend. Check manual. (1704a2b2-0...	➔
2023-01-26 13:59:59	vor 6 Monaten	⚠ Warning	vdx-symmetry-alerts	[thermal_symmetry_longterm_anoma...	C04 B01 Rack 03: Slow thermal asymmetry trend. Check manual. (1704a2b2-0...	➔
2023-01-26 01:59:59	vor 6 Monaten	⚠ Warning	vdx-peer-group-alerts	[peer_cap-symmetry_daily]	C04 B01 Rack 05: Capacity symmetry differs significantly from peers. Check m...	➔
2023-01-26 01:59:59	vor 6 Monaten	⚠ Warning	vdx-symmetry-alerts	[thermal_symmetry_longterm_anoma...	C04 B01 Rack 03: Slow thermal asymmetry trend. Check manual. (1704a2b2-0...	➔
2023-01-25 13:59:59	vor 6 Monaten	⚠ Warning	vdx-symmetry-alerts	[thermal_symmetry_longterm_anoma...	C04 B01 Rack 03: Slow thermal asymmetry trend. Check manual. (1704a2b2-0...	➔



The most expensive degrading part of the energy transition deserves proper monitoring & treatment

Data access is everything – get in touch as early as possible

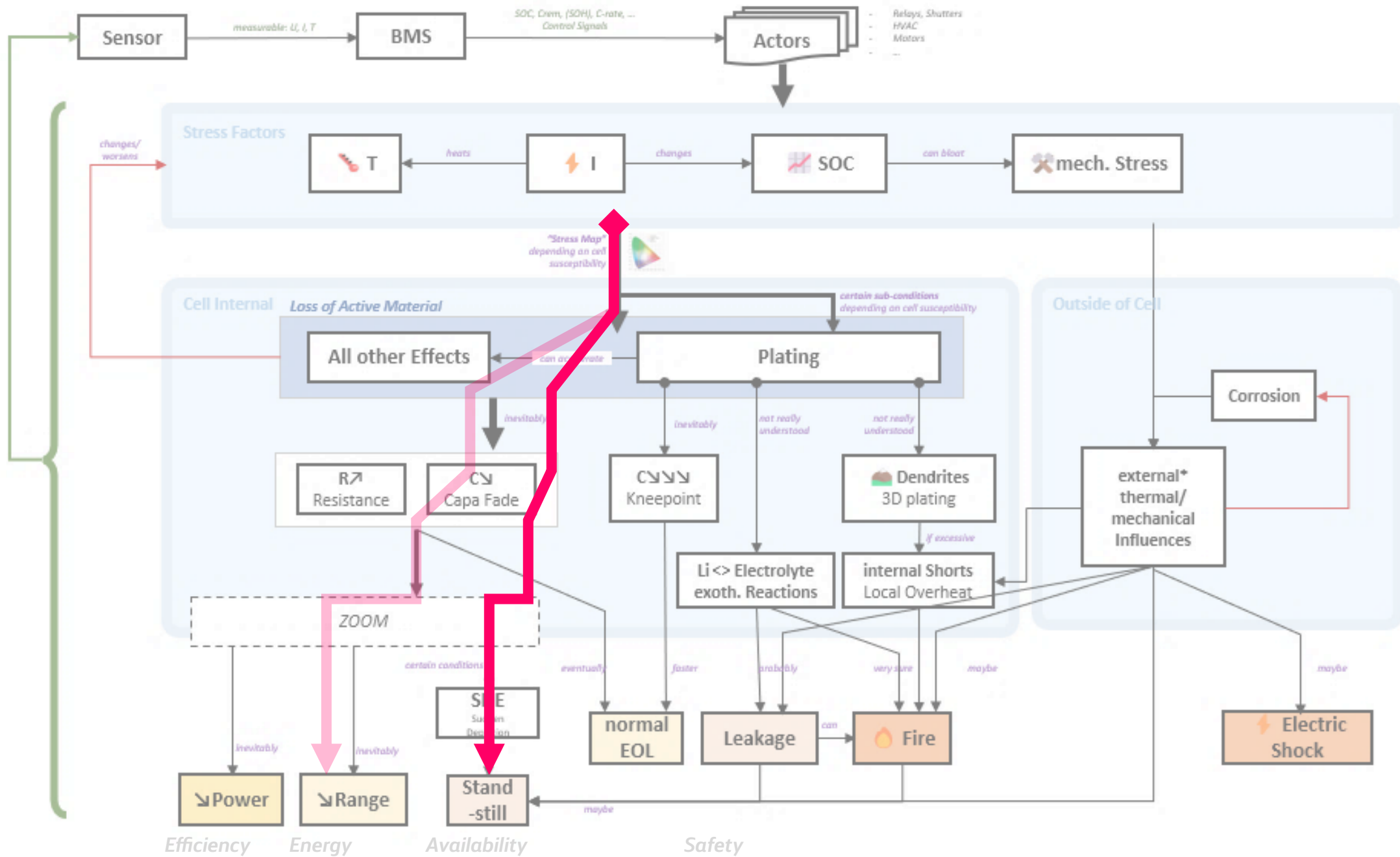


Thank you!

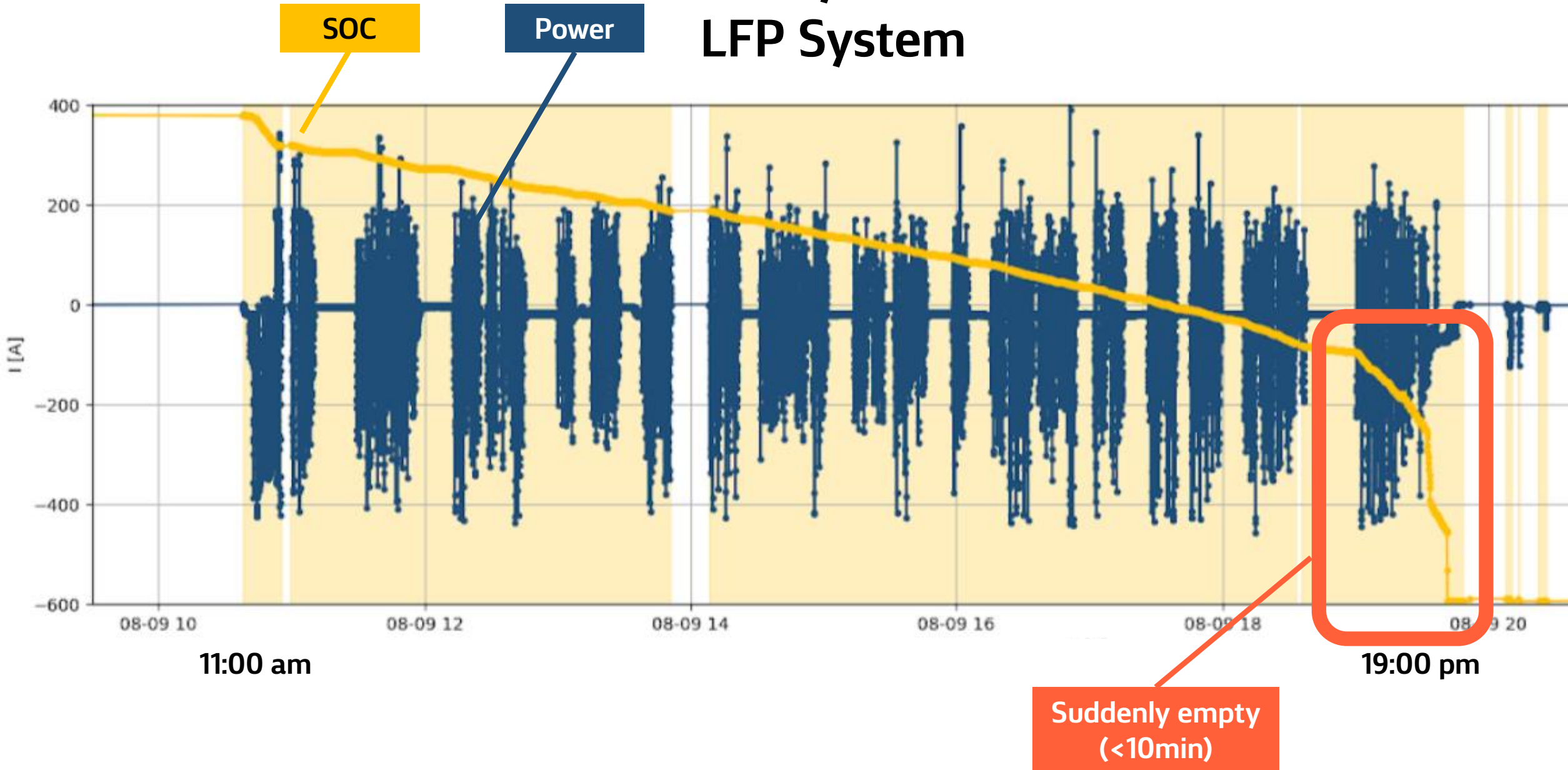
 **Get in Touch**

sales@volytica.com

+49 351 87 95 87 - 00

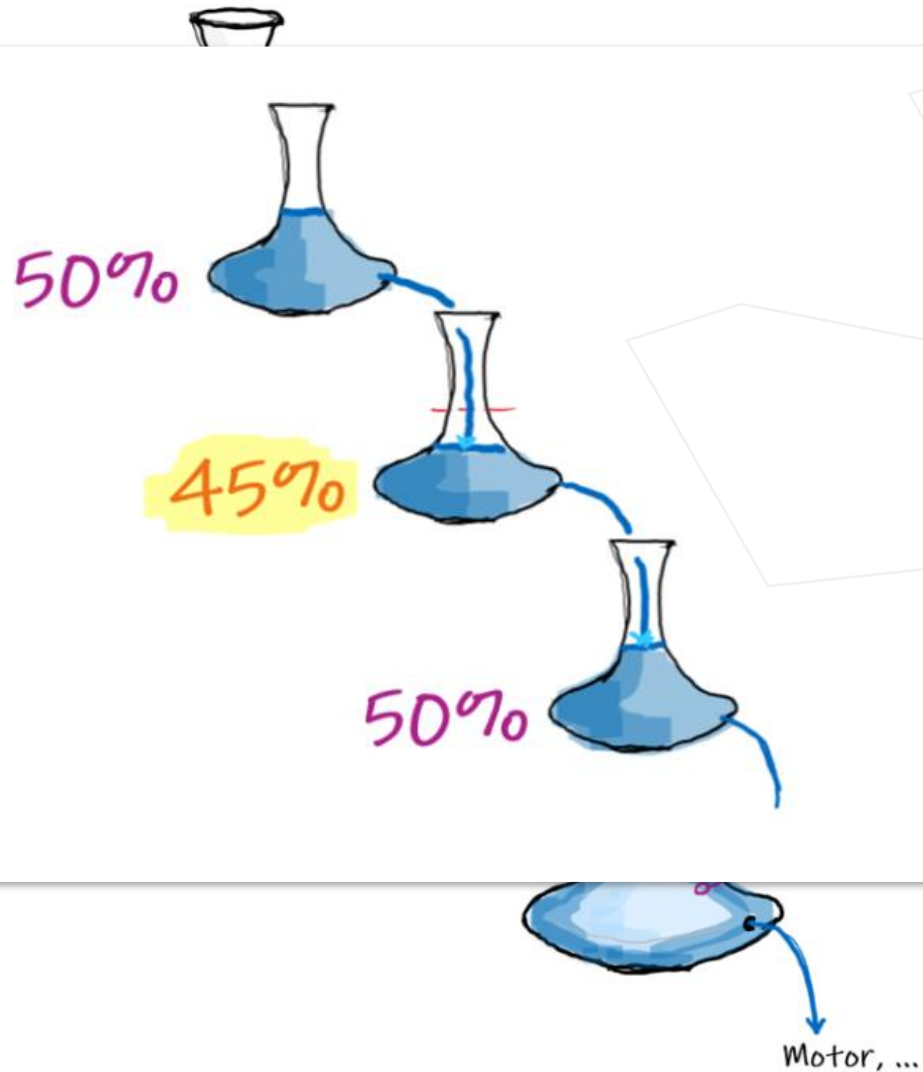


1 day of a LFP System





Sometimes, all of a sudden, a battery stops working.
One reason for “sudden depletion” is disbalance.

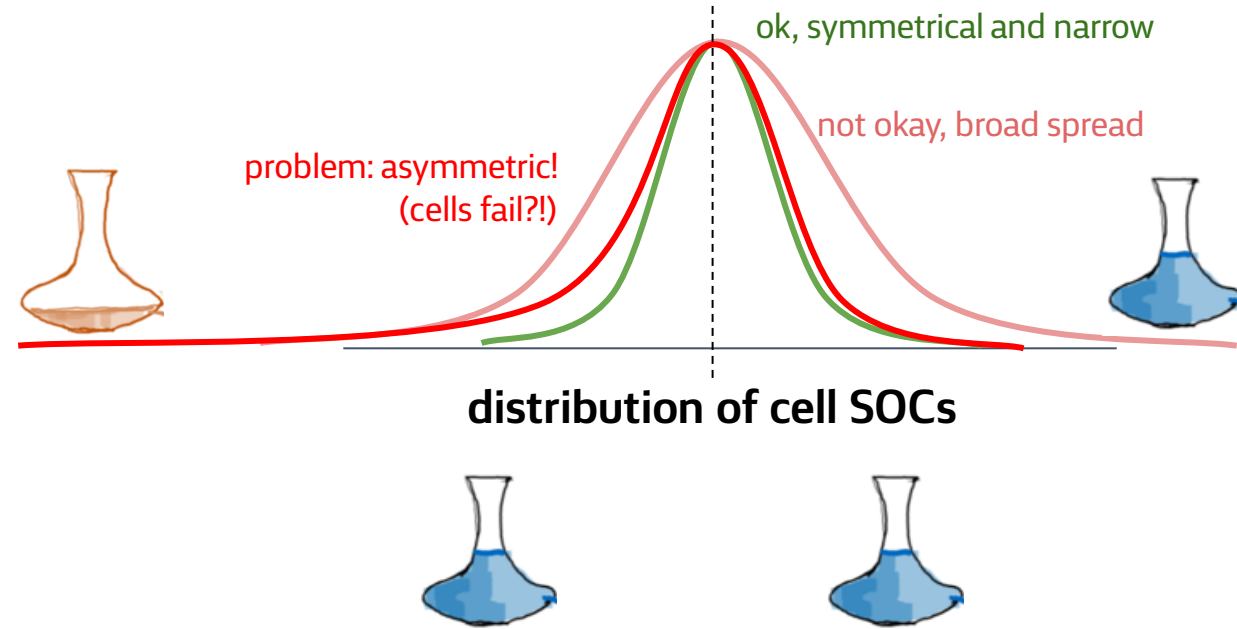


Click to learn more!



Disbalance impact on application, and the potential connection to safety-related issues

- 100-1000s of cells per system: all must behave **identically!**
- esp. all must have the same SOC at (almost) all times
- → balancing circuits take care (only works under certain conditions, so OEM recommendations must be adhered to!)
- if the circuit has problems, or single cells start failing, this is noticeable in the system disbalance (slow or fast trends)
- we automatically estimate this disbalance and analyse for trends



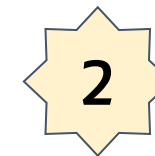
Anomaly Levels



No evidence for issues



Little evidence, no trends



Slow trends, monitor!



Fast trends, immediate action



Capacity & Efficiency Fade

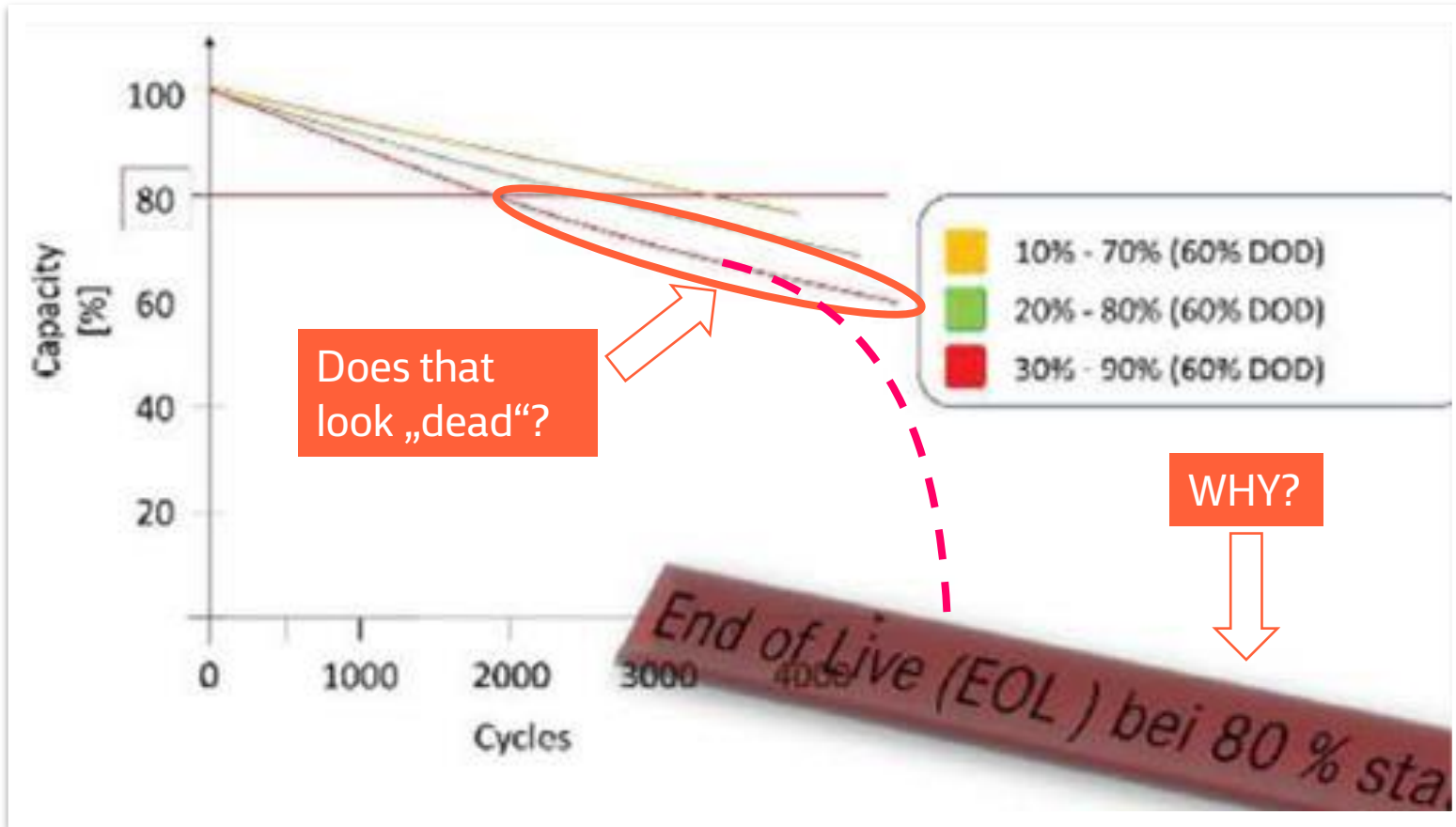
Availability

Safety → not today



End of Warranty Life criteria?

Hang on ... why “End of Life = 70 or 80%”?



Safety?

- no, not really (see later)

Usability?

- well, that depends on route, right?

💡 **It's weird, nobody really knows!**

(There is a theory of a legacy test protocol from 1996 from USABC)

EoL Criteria need a makeover

We waste €50bn by premature scrapping

Batteries are not worthless @ EOW

They can be used longer

Considerable Residual Value

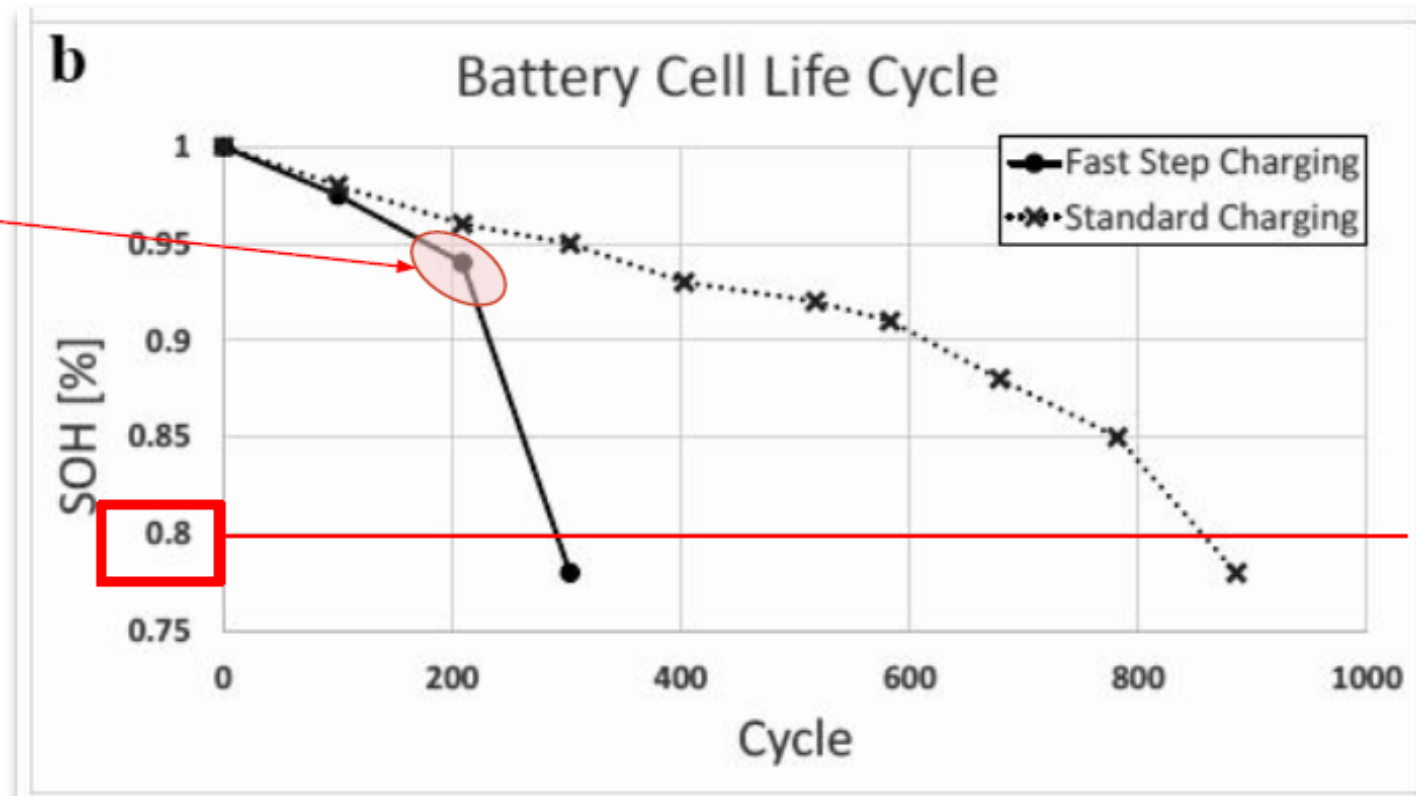
But only if you can prove it!

End of Warranty Life criteria?

Hang on ... why “End of Life = 70 or 80%”?



Stress- induced onset



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20 September 2023

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4:00 pm – 5:00 pm | CEST, Berlin

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BESS diagnostics for holistic lifecycle management

Q&A



Marija Maisch
Editor
pv magazine



Vincenzo Putignano
Head of O&M BESS at global level
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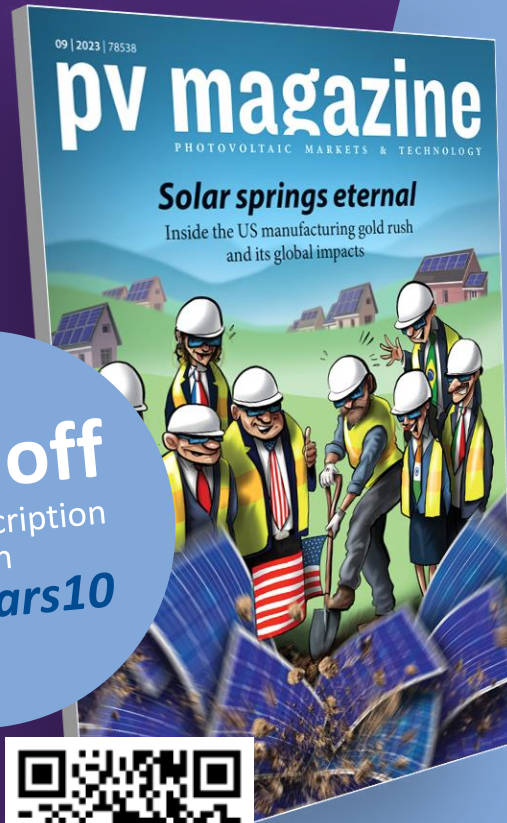


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Monday, 25 September 2023

10:00 am – 11:00 am CEST, Berlin, Paris, Madrid
6:00 pm – 7:00 pm AEST, Sydney

Tuesday, 26 September 2023

11:00 am – 12:00 pm EDT, New York City
5:00 pm – 6:00 pm CEST, Berlin, Paris, Madrid

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