WEBINAR:

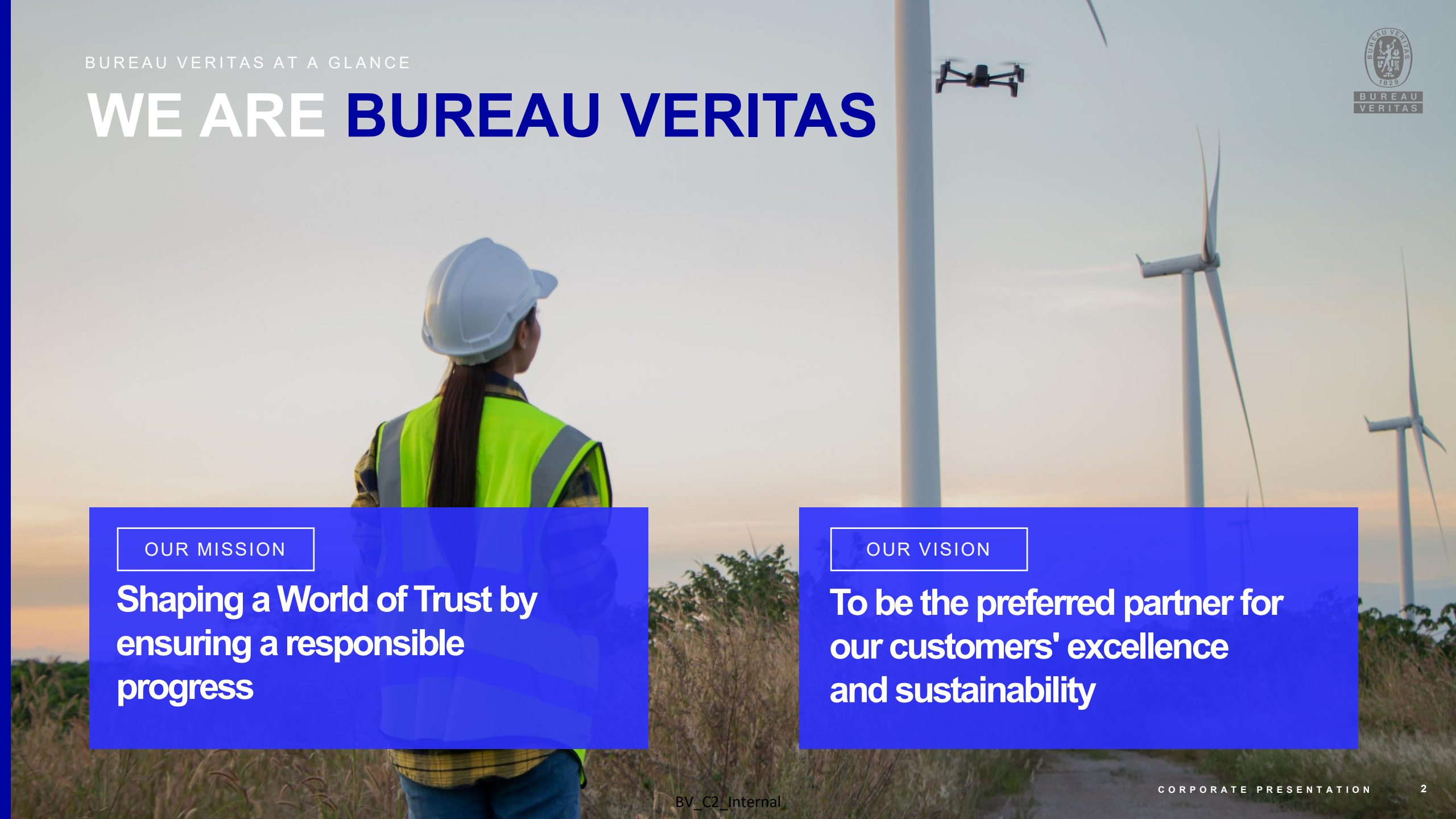
Delivering Reliable and Bankable Battery Energy Storage System (BESS) Projects in Africa

Mitigating Project Risks During Design and Procurement

29 July 2026 | 10 AM CAT

BUREAU VERITAS 1828

WE ARE BUREAU VERITAS



OUR MISSION

Shaping a World of Trust by ensuring a responsible progress

OUR VISION

To be the preferred partner for our customers' excellence and sustainability

KEY FIGURES

€6.4
billion

FY 2025

82’000
employees

400,000+
clients

~1500
offices & laboratories

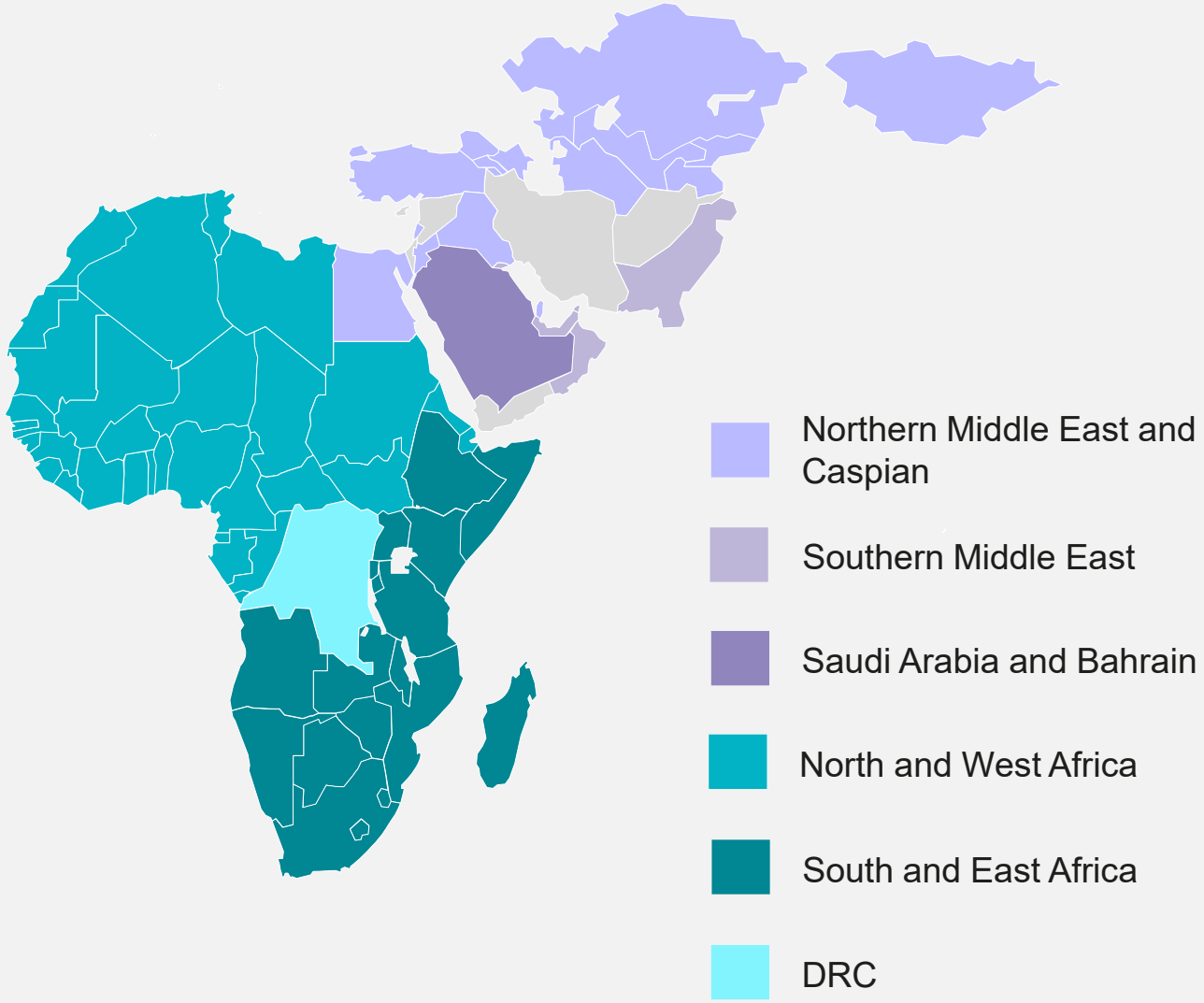
IN 140 COUNTRIES

MIDDLE EAST, CASPIAN & AFRICA

8,650
employees

210+
offices & laboratories

52
countries



OUR REACH

Our **TRUSTMAKERS** build trust at every stage of the supply chain from source to society.

- **LAB TEAMS**
- **DESK TEAMS**
- **FIELD TEAMS**
- **EMBEDDED TEAMS**

INDUSTRIALS AND COMMODITIES

INDUSTRY
Renewable Energy (Wind, Solar, BESS), Oil & gas, Power & utilities, Industrial products certification (IPC),

MARINE & OFFSHORE

COMMODITIES
Metals & Minerals, Agrifood

FUELS

URBANIZATION AND ASSURANCE

BUILDINGS & INFRASTRUCUTURE

CERTIFICATION incl TRANSITION SERVICES

CYBERSECURITY SERVICES

GOVERNMENT SERVICES

CONSUMER PRODUCTS

CONSUMER PRODUCTS

TECHNOLOGY

CLEAN ENERGY PROJECTS
YOU CAN TRUST

As part of its LEAP I 28 Strategy, Bureau Veritas has expanded its global centre of technical and engineering excellence to provide comprehensive lifecycle solutions for clean energy projects globally.

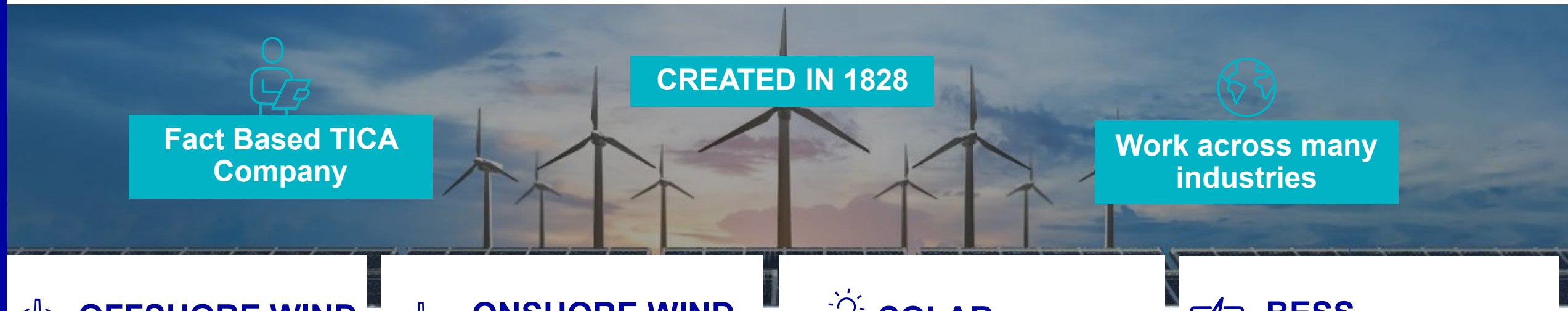
Over a century of expertise in the power sector.

Decades of experience in wind and solar.

Thousands of projects globally

- Acquired :
  - Bradley Construction Management
  - ArcVera Renewables
  - Versatec Energy and
  - Solida
- Bureau Veritas provides end-to-end services for :
  - wind,
  - solar,
  - storage,
  - green hydrogen and
  - optimized hybrid projects.

BUREAU VERITAS



Fact Based TICA Company

CREATED IN 1828

Work across many industries

OFFSHORE WIND
15+ years experience

70+ GW
Installed capacity

150+
Projects globally

ONSHORE WIND
20+ years experience

300+ GW
Installed capacity

2,800+
Projects globally

SOLAR
20+ years experience

250+ GW
Installed capacity

2,000+
Projects globally

BESS
10+ years experience

29+ GWh
Installed capacity

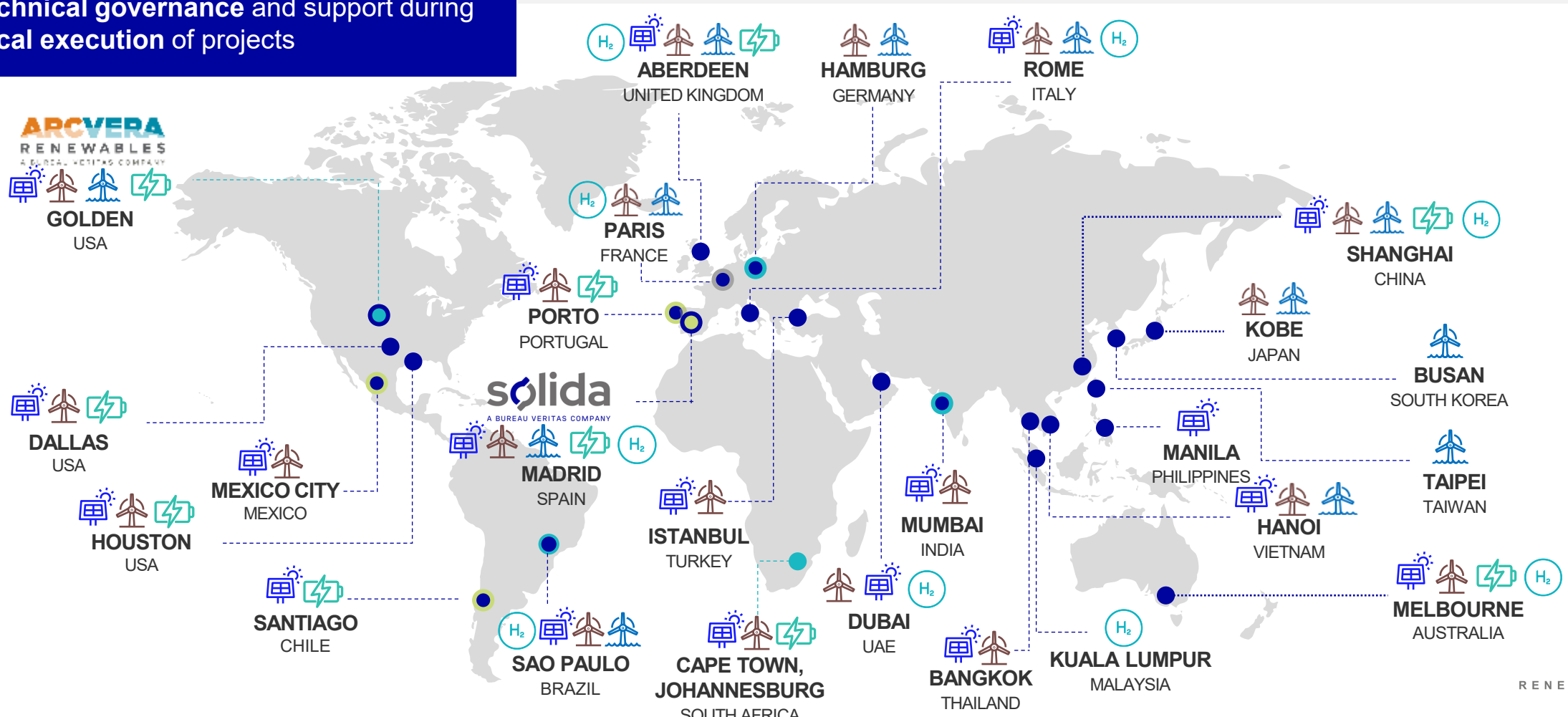
100+
Projects globally

70+
Renewables Track record in countries

MASTERING ENERGY TRANSITION
BV'S CENTERS OF EXPERTISE

BV's Centers of Expertise are under **global technical governance** and support during **local execution** of projects

Your reliable global partner providing local assistance in **140+ countries**



Battery Storage

Onshore Wind

Offshore Wind

Solar

Hydrogen

RENEWABLES

END-TO-END PROJECT SERVICES

As part of our **LEAP I 28 Strategy,** Bureau Veritas has formed a new **Global Technical Platform,** now able to provide a comprehensive range of Renewable project services.

BUREAU VERITAS' CORE STRENGTHS

CERTIFICATION
SUPPLY CHAIN SERVICES
QA/QC INSPECTIONS
GLOBAL REACH

ENERGY & RESOURCE ASSESSMENTS
POWER PERFORMANCE TESTING
TECHNICAL DUE DILIGENCE

ARCVERA RENEWABLES
A Bureau Veritas Company

ARCVERA'S CORE STRENGTHS

GLOBAL TECHNICAL PLATFORM

TECHNICAL ADVISORY
ENGINEERING & OWNERS ENGINEERING
SUPPLY CHAIN SERVICES
ASSET INTEGRITY & RELIABILITY

OWNER'S ENGINEERING
BASIC & DETAILED ENGINEERING
CONSTRUCTION MANAGEMENT
PROJECT OPTIMISATION

solida
A BUREAU VERITAS COMPANY

SOLIDA'S CORE STRENGTHS

COMBINED STRENGTHS

DRIVERS FOR BATTERY ENERGY STORAGE SYSTEMS (BESS)

DRIVERS FOR BESS: A KEY PART OF THE ENERGY TRANSITION

1

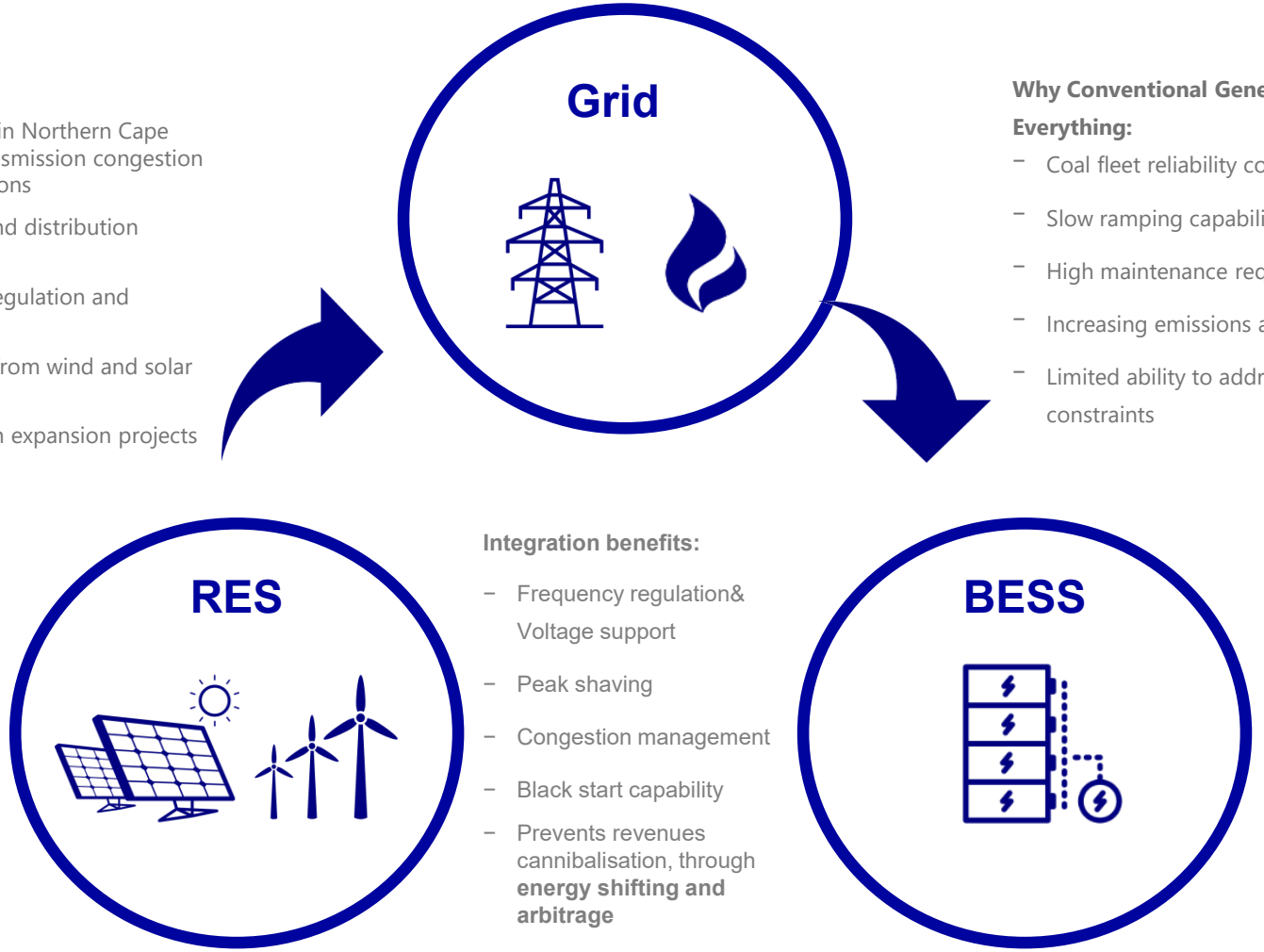
Increase of RES share in energy mix due :

- Eskom Supply Constraints and Energy Security
- Government Policy and Procurement
- Corporate PPAs and private generation market
- Rapid decline Solar PV and Wind LCOE
- Decarbonisation commitments and ESG targets Regulatory Reforms and Private Sector Participation

2

Grid Challenges:

- High curtailment risk in Northern Cape renewable zones Transmission congestion limiting new connections
- Aging transmission and distribution infrastructure
- Need for frequency regulation and reserves
- Increasing variability from wind and solar penetration
- Delays in transmission expansion projects



Integration benefits:

- Frequency regulation& Voltage support
- Peak shaving
- Congestion management
- Black start capability
- Prevents revenues cannibalisation, through **energy shifting and arbitrage**

3

Why Conventional Generation Cannot Solve Everything:

- Coal fleet reliability concerns
- Slow ramping capabilities
- High maintenance requirements
- Increasing emissions and carbon costs
- Limited ability to address localized grid constraints

4

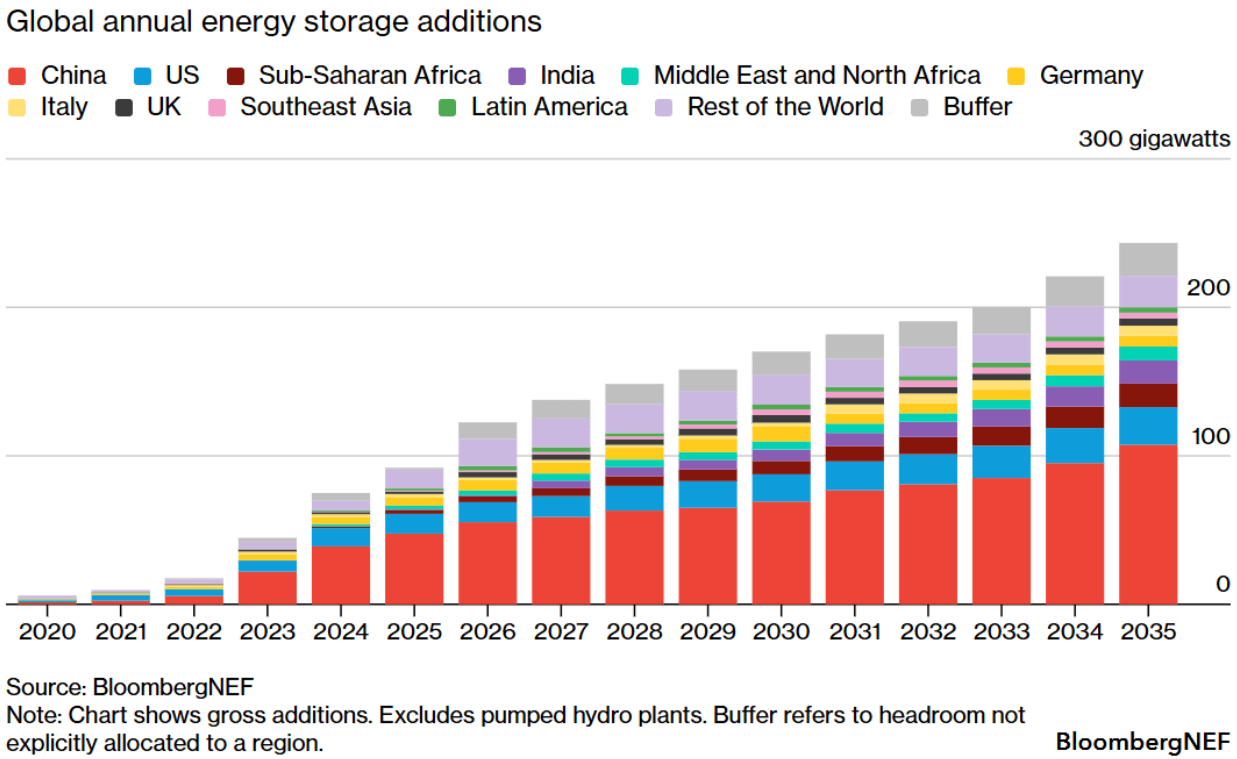
Renewable Energy Benefits

- Curtailment reduction
- Energy shifting
- Improved PPA performance
- Increased renewable hosting capacity

Customer Benefits

- Backup power
- Demand charge reduction
- Self-consumption optimization
- Reduced diesel consumption

BESS MARKET OUTLOOK



KEY DRIVERS OF DEVELOPMENT

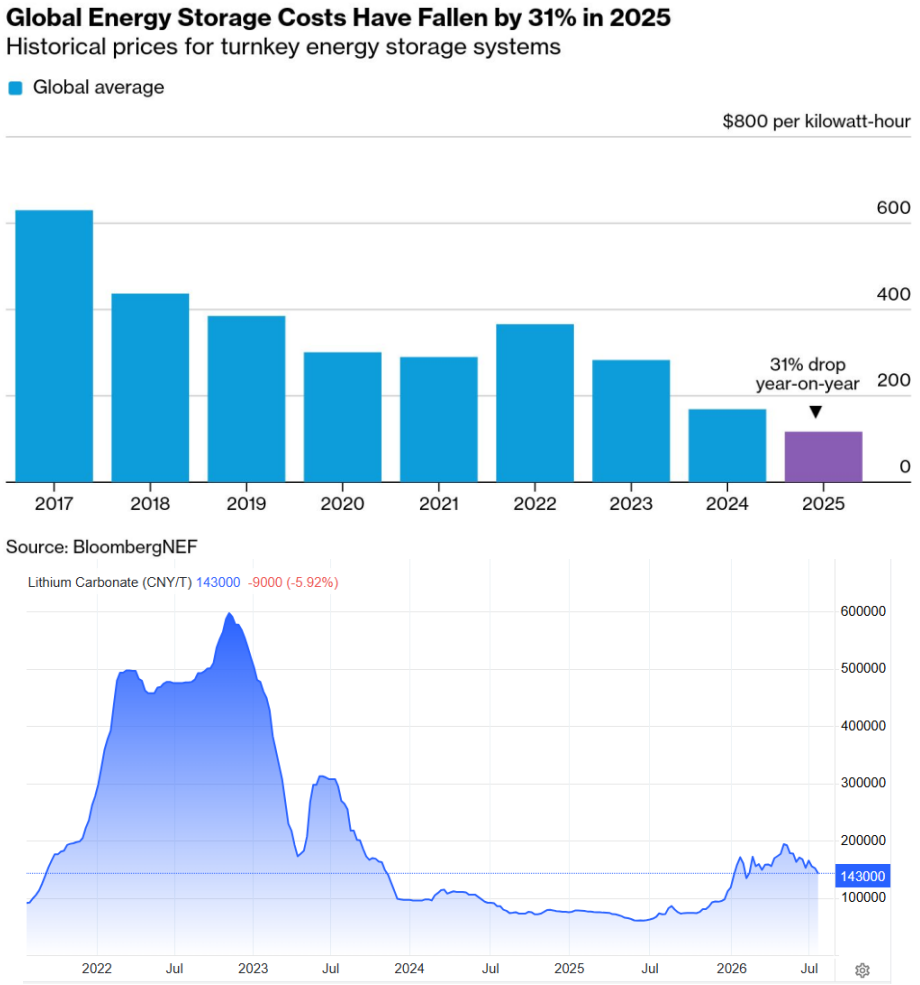
Common denominators

- Large penetration of renewables
- Limited generation / grid flexibility
- National push with high targets
- Evolved electricity markets
- Clear regulatory framework
- Visibility of present and future revenue streams
- AI and Data Centers

STRONG DECREASE IN BATTERY COSTS

Technology advancements and integration optimization as may drivers of cost

- 85% battery cells manufactured in China, although re-shoring / diversification initiatives are taking place.
- Fuelled 90% cost reduction since 2010, higher energy densities and longer lifetimes, reaching cost <100 $/kWh for the first time in 2025.
- Several synergies, learnings from a safety and performance perspective, but also availability conflicts between batteries for EVs and for BESS.
- 2026 being a rebound year in terms of costs, with stable if not higher prices at project level due to raw materials and workmanship costs.



APPLICATIONS STACKING IS KEY FOR VALUE MAXIMIZATION

Arbitrage

Maximising the value of renewable energy demands an adequacy between resource availability and grid needs.

Wholesale Market
Intra-day market
Continuous intraday

Ancillary services

Participation in ancillary services markets, providing grid operators flexible power capacity.

Curtailment Avoidance

Very high levels of renewable generation, grid injection limitations, market prices may lead to several consecutive hours of grid injection curtailment.

Resilience

Several electric grids are prone to outages due to being weakly connected and/or due to recurrent extreme weather conditions, which BESS tackles.

Peak Shaving

Demand peaks present significant technical and economic challenges in the planning and operation of grids. BESS can address such peaks.

Capacity Markets

Medium to long term contracts, market bases, for providing firm, dispatchable power and ensure security of supply of the power system.

Firming Corporate PPA (24/7 CFE)

Corporations increasingly seek ways to firm their contracted wind and solar power to ensure being fed 24/7 with carbon-free generation.

Inertia

Connected through advanced power electronics, namely grid-forming inverters, BESS can contribute with inertia of the power system.

Primary Frequency Control

BESS can very rapidly compensate for deviations in frequency, charging or discharging to compensate generation or load fluctuations.

Fast Frequency Response
Frequency Containment
Dynamic Regulation

Reserve Provision

By being able to rapidly providing reserve, according to the power system needs, BESS can support stabilisation of grid frequency.

Operating Reserve
Automatic Frequency Restoration
Manual Frequency Restoration
Replacement Reserve

Voltage Control

While voltage is highly local to control, BESS by using its converters can provide reactive compensation to keep grid within technical limits.

Capacity Booster

BESS can be used as an alternative or to defer grid capacity investments (e.g. lines/substations), by supporting management of local congestions.

Black Start

In case of failure in the continuity of service, BESS can support the grid in re-starting, participating in service restoration schemes.

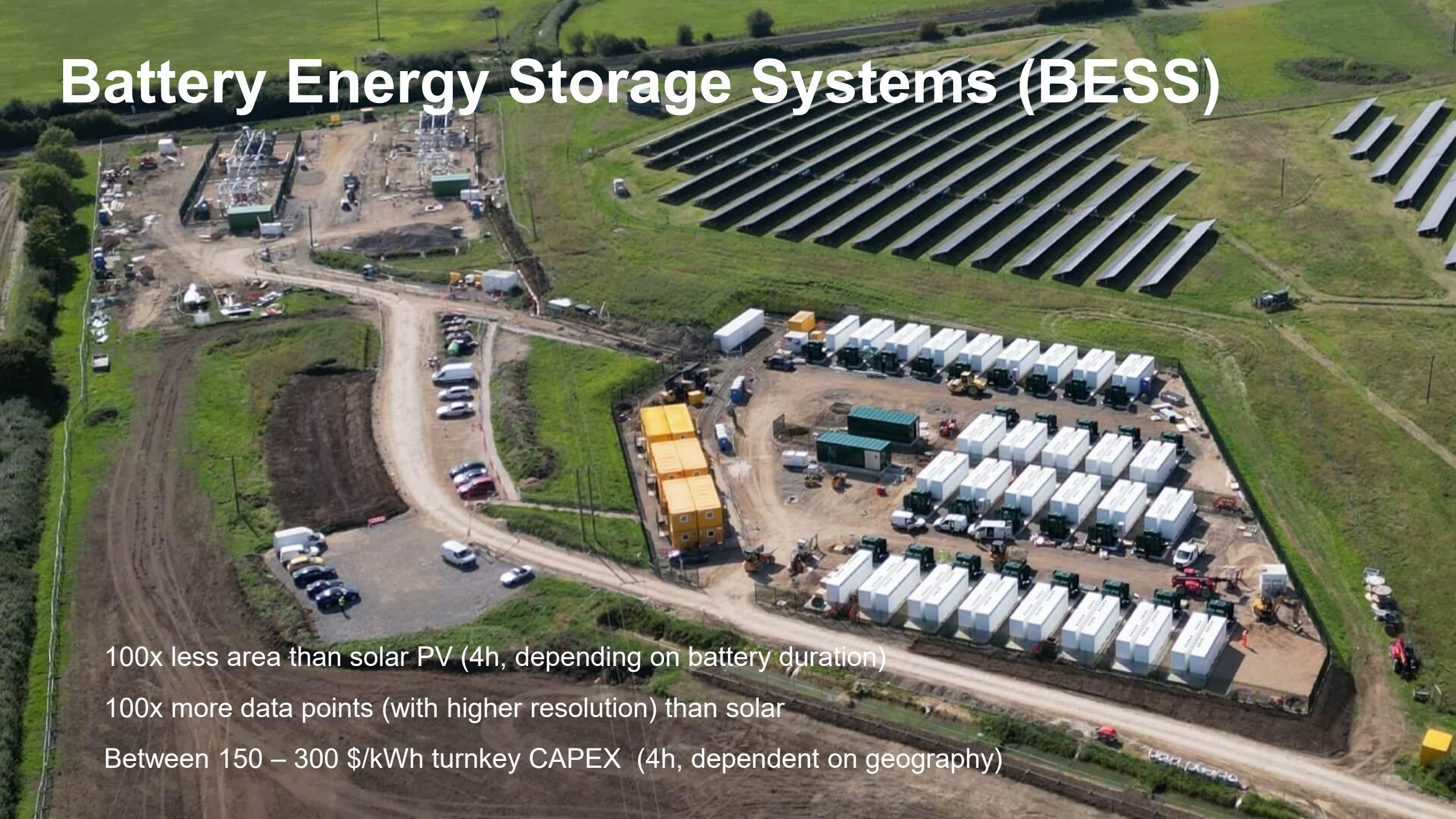
Conventional Generation offset

Different places (e.g. islands, hospitals) are weak electrically isolated or require backup power. BESS can displace traditional approaches.

What is monetizable and what are the requirements?

What is stackable and what are the technical implications?

Battery Energy Storage Systems (BESS)



100x less area than solar PV (4h, depending on battery duration)

100x more data points (with higher resolution) than solar

Between 150 – 300 $/kWh turnkey CAPEX (4h, dependent on geography)

BESS: KEY DESIGN AND PROCUREMENT ASPECTS

BESS: MAIN PROJECT RISKS

Sizing & Revenue Streams

Properly sizing BESS in different integration scenarios and set of applications, based on a detailed power market model is still key in more mature markets and key in new ones.

Lifecycle & Usage

Battery degradation is high risk in a BESS project. Proper battery knowledge and the assessment of its expected performance during its lifetime, with accurate degradation calculation is key.

Safety

Battery fire safety is a crucial aspect from product to project level, with implications on design, construction and operation.

Product and Project Quality

From manufacturing defects, construction and installation issues, as well as commissioning delays are key challenges in a maturing industry.

Bankability

Workmanship warranties, Performance guarantees, O&M contracts and insurance are fundamental aspects of project's bankability.

Battery Performance

A mainly digital asset that requires proper monitoring, performance assessment and guarantees check.

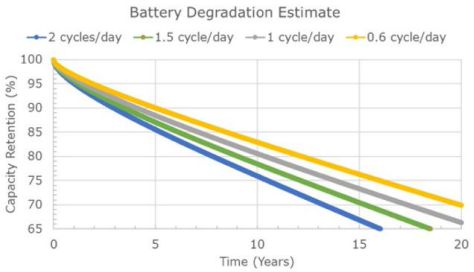
THE NEED FOR OPTIMIZED SIZING

BESS Sizing

What can be avoided?

- **Battery oversizing**: 15 - 25% may occur in typical projects.
- **Reduced battery lifespan**: inadequate control at BMS and EMS level may reduce lifespan of battery.
- **Increased O&M cost**: lead to premature failures, excess degradation may cause earlier need for augmentation.
- **Lost revenue**: failure to deliver usable energy, increased degradation or unoptimized charge/discharge pattern, with inability to stack services.

		Why?	How?
Technology	Usable Energy & Efficiency	• Properly sized assets • Performance warranties • Structure business case	• Standard testing requirements • Simulation with detailed modelling
	Expected degradation	• Properly sized assets • Define overbuilt vs augmentation strategy • Ensure performance	• Physics-based simulation • Independent cell testing and validation • Battery data analysis
	State of Charge & Health	• Safety • Avoid downtime and extra O&M • Ensure bids may be delivered	• BMS HW and SW architecture and functionalities • Battery data analysis
Market	Supply, demand, price	• Understand cycling needs during development • Enable optimisation during operation	• Advanced simulation tools, integrating AI • Up-to-date with market and forecasting
	Operational Optimisation	• Maximise economic return • Integration with renewables	• Advanced simulation tools, integrating AI • Integration of trading and control and communication platforms



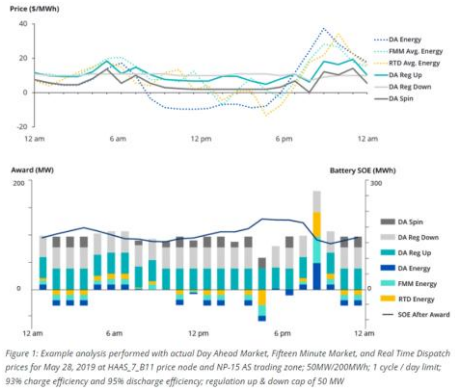
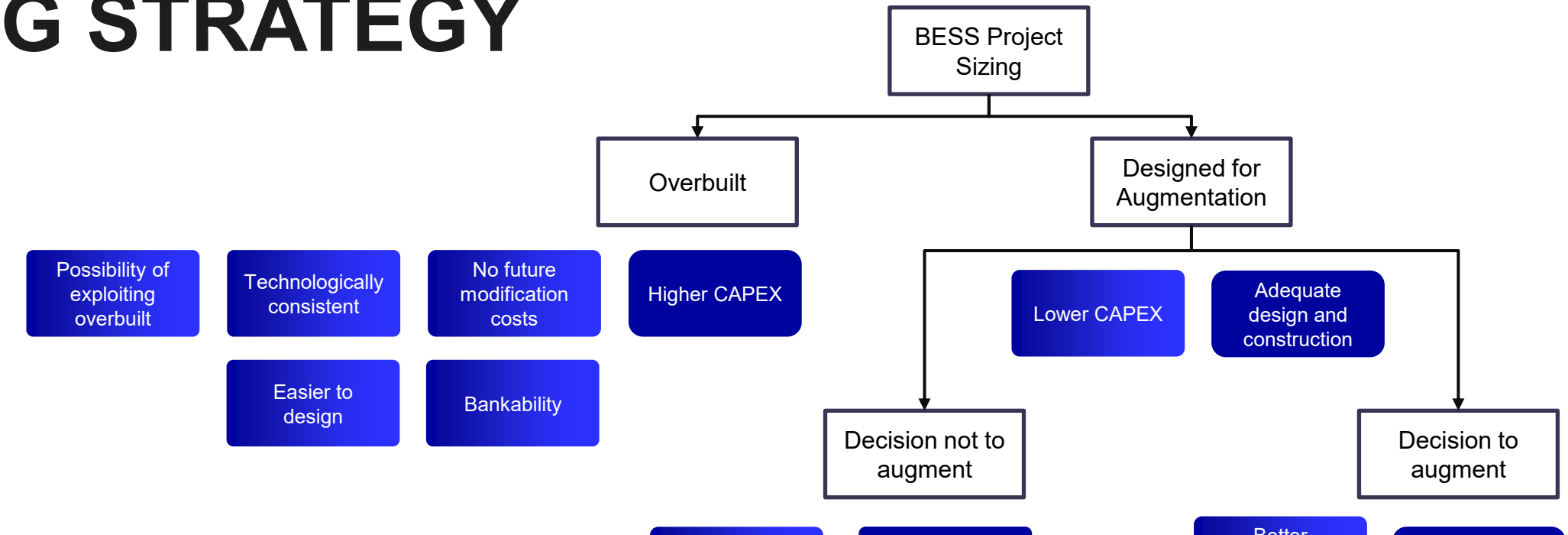
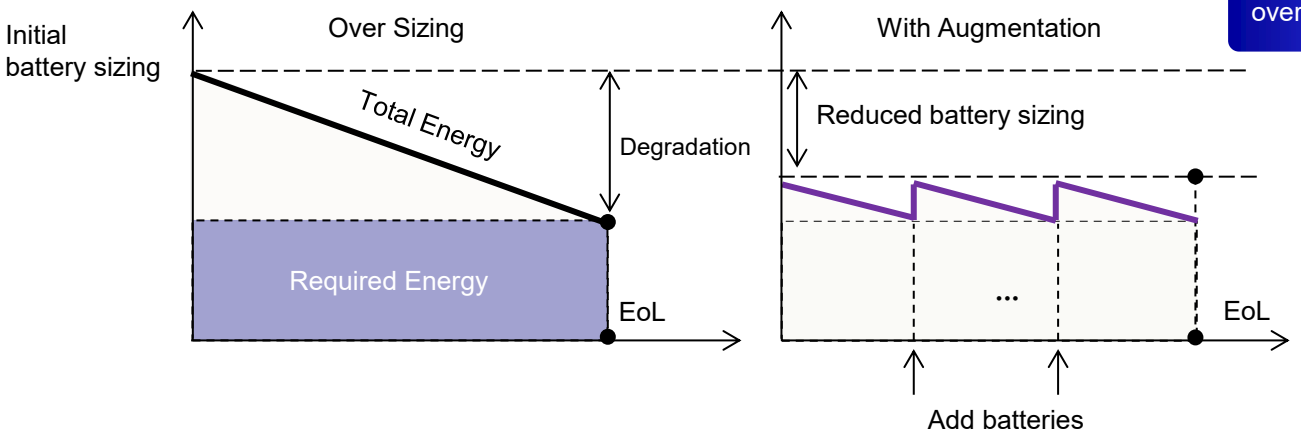


Figure 1: Example analysis performed with actual Day Ahead Market, Fifteen Minute Market, and Real Time Dispatch prices for May 28, 2019 at HAAS_7_B11 price node and NP-15 AS trading zone; 50MW/200MWh; 1 cycle / day limit; 93% charge efficiency and 95% discharge efficiency; regulation up & down cap of 50 MW

BESS DESIGN CHALLENGES ARE FOCUSED ON BESS SIZE AND BESS TECHNOLOGY WHICH ARE RELATED TO CHALLENGES OF OTHER NATURE LIKE MARKET, FINANCIAL, RISK OR PROCUREMENT.

SIZING STRATEGY



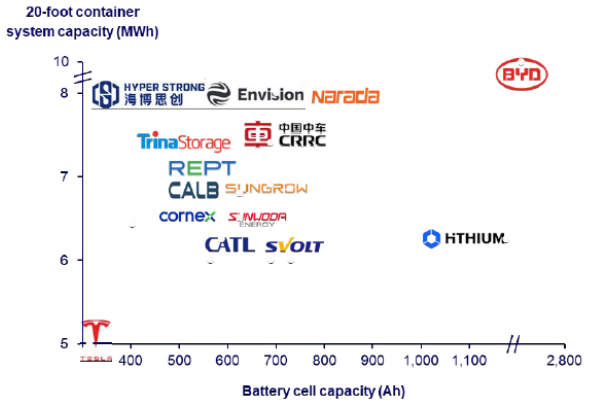


BESS: PRODUCT DYNAMICS

ESS BATTERY CELL CAPACITY BY MANUFACTURERS

Manufacturer	300+ Ah	500+ Ah	600+ Ah
CATL	306/314	587	
BYD	300/320/340/350		2710
EVE	304/306/314	560	628/648
Gotion	300/314/330/340	588	650
CALB	314/392		640
REPT	306/314/320/340/345/392	564/587	625/688
BATTERO TECH	314/324		
HTHIUM	300/314/320	587	1130/1175/1300
鹏辉	314/320	590	
SUNWODA ENERGY	314		625
TrinaStorage	306/314	530/587	
Envision AESC	305/315/350	530	700
SVOLT	325/350/370		684/710/730/770
Narada	305/314/320/340	587	690/783
cornex	306/314/315/320	588	648/650/684/688

LARGEST 20-FOOT ENCLOSURE CAPACITY BY MANUFACTURERS



Manufacturer	Product	System Capacity by Container Size	Illustration	Structural Highlights
FLUENCE	Smartstack	7.5 MWh/24 ft		Two-layer design: upper battery pod + lower PCS/control cabinet
CATL	TENER Stack	4.5 MWh/20 ft		Two 20-ft containers, each with 4.5 MWh, stacked to form a high-capacity 9 MWh storage system
海博思创 HYPER STRONG	HyperBlock M	3.2 MWh/10 ft		Each 10-ft module offers 3.125 MWh (DC) /3.2 MWh (AC), scalable via 2–8 modules arranged in a "side-by-side + back-to-back" layout
HTHIUM	∞Power 6.25MWh	6.25 MWh/20 ft		Single 20-ft container with 4 modular battery racks (4-hour) or 8 racks (2-hour)
SUNGROW	PowerTitan 3.0	3.45 MWh/10 ft 6.9 MWh/20 ft 12.5 MWh/30 ft		Three sizes available: Flex (3.45 MWh/10 ft), Classic (6.9 MWh/20 ft), Plus (12.5 MWh/30 ft)
TESLA	Megapack 2XL	3.9 MWh/29 ft		Two-container configuration with integrated battery modules, inverters, and thermal management

Longer duration

Race for density

AC Block vs DC Block

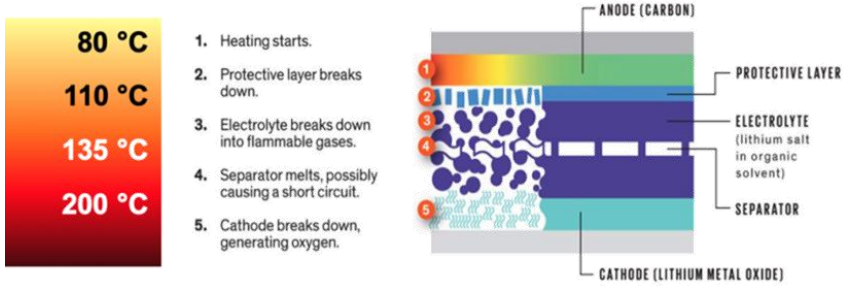
China vs The World

BESS FIRE SAFETY

Victoria Big Battery Fire
(Above & Below)
Scale of Incident vs. Installed System

Fire Safety is central to a BESS project, from design to operation, requiring quality verification in all project lifecycle. Compliance with main standards (e.g. NFPA855, UL 9540A) is essential, with the industry moving towards large-scale fire testing, but needs to be looked at project level design.

- Risk of Thermal Runaway
- Propagation of Fire / Explosion mitigation
- Prevention & Preventive Maintenance
- Proper Emergency Plans & Training



- While failure rate as decreased with the addition of BESS, still more than 50% of installation have less than 2 years (critical period).
- More than two-thirds of the failures found during FAT are at system/BESS Container level and not at battery cell and battery module level. Particularly relevant subsystems include the fire detection and suppression system, auxiliary circuit panels and thermal management system defects (e.g. liquid cooling leakages, etc.)
- Relevance to FAT and commissioning as more BESS products are integrated solutions (e.g. +5MWh containers with batteries and auxiliaries).
- Safety in BESS deployments start with stakeholders' insights and early involvement, from the OEMs to developers and first responders.

FACTORY ACCEPTANCE TESTS

Traditional BESS FAT relies on sampling and pass/fail criteria — hidden defects often appear only after COD, when fixes are costly.

MEASURABLE ASSURANCE OF BATTERY QUALITY AND READINESS

Translates FAT outcomes into quantified performance and uniformity indicators
Confirms container-to-container consistency, not just compliance
Identifies latent quality and integration risks ahead of shipment
Strengthens acceptance, handover, and warranty baselines

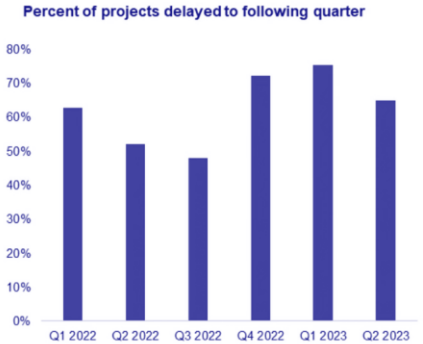
WHAT CAN BE ACHIEVED WITH IMPROVED FAT

Verified usable capacity & round-trip efficiency
Cell, rack, and module imbalance detection
Thermal inhomogeneity & early overheating risks
Abnormal degradation or manufacturing anomalies

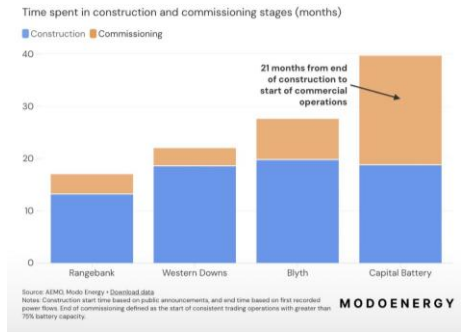
EXTENDING FAT SUPERSIVION AND QA/QC INSPECTIONS:

- Fix issues when they are cheapest (before shipping)
- Reduced commissioning & SAT risk
- Stronger warranty & claims position
- Improved bankability and investor confidence

COMMISSIONING



Source: Wood MacKenzie



DELAYS ARE CRITICAL

Penalties for delays and potential for snowball effect
Potential revenues lost
Warranties and performance at risk

TRANSFER OF RISKS

Transfer of responsibility between contractor to client
Verification of warranty conditions & potential buydowns
Most payment terms met

LIMITED PERFORMANCE

Accepted terms may hinder BESS performance
Initial performance may be limited
Ensuring connectivity, availability and optimized operation

BESS PROCUREMENT

DIFFERENT COMPLEXITY

- Full EPC wrap vs multi-party approach, with potential overlapping scopes and grey areas
- Multiple performance metrics that translate into different potential liabilities (e.g. capacity, RTE, availability)
- Performance definitions with high variability among OEMs, with no accepted standard or framework
- O&M requiring 24/7 operations to ensure safety and revenue capturing
- Bankability, particularly in new markets, as lenders have lower familiarity and existing track-record
- Highly integrated products, where understanding of connection requirements, interfaces, connectivity is crucial.

INTERFACES AND BOUNDARIES

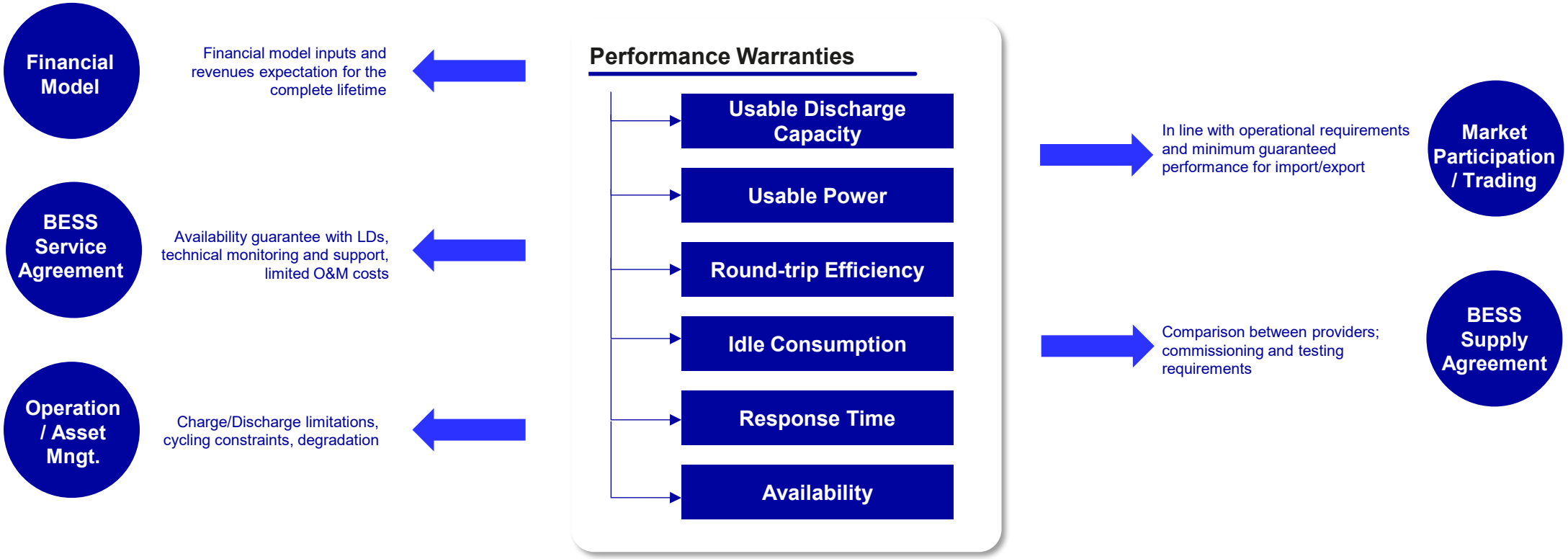
- Clear responsibilities and actual scopes are critical to de-risk technically and commercially
- Interfaces between BESS OEM/Integrator, EPC /BoP contractor, EMS/PPC and SCADA provider need proper management, visible to the asset owner
- Requirements from other interfaces such as O&M operator, asset management, route-to-market platform (if applicable) need to be known early. This will impact lenders assessment and insurance providers.
- Critical project scopes, that often expose the split-scope structure and require commitment from multiple parties include PPC, EMS and SCADA integration, connectivity and data visibility prior to COD, substation and MV station commissioning, protection selectivity and coordination, fire alarm and emergency stop logic.

TYPICAL PAIN POINTS

- **Availability definition and verification**
- **Warranty conditions and correction curves**
- **Start of warranty potentially before COD**
- **Contract placement of warranties**
- **Liquidated Damages (LDs) threshold and caps**
- **O&M contract / LTSA impact on guarantees**
- **Data availability and visibility**
- **Limitation on SW and critical procedures (e.g. calibration, balancing) not auditable**
- **Testing procedures and operational flexibility**

BESS WARRANTIES

ENSURING COVERAGE FOR THE USE



BESS WARRANTIES

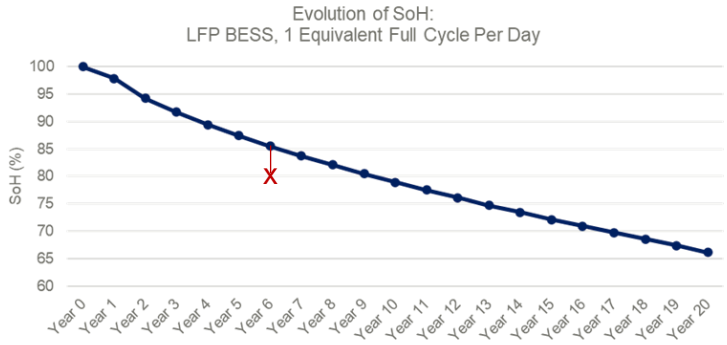
FLEXIBILITY IN A CHANGING ASSET & MARKET

- BESS warranty terms in multiple forms, from energy throughput, cycles histogram, or the current trend of flexible warranties, where warranted capacity depends on the use.
- Onus on the BESS owner to ensure best model for its case, depending as well on the uncertainty of its business model and market rules that may dictate different battery use.
- Evolution of the market associated with a changing asset in new markets needs to be tackled by introducing sufficient flexibility, from design, procurement to operational.

The need to define a duty cycle and operating conditions

vs

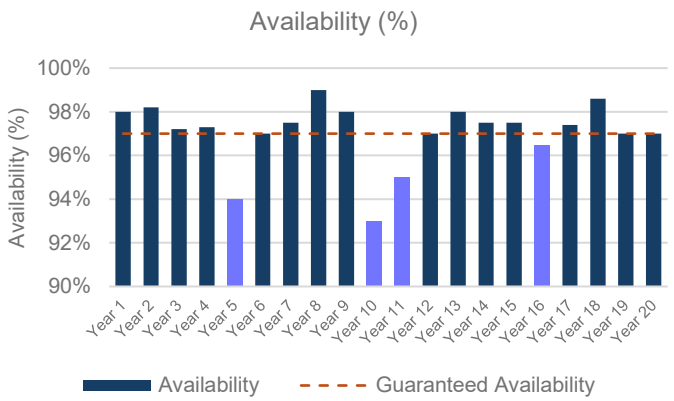
The changing grid and market



Example of conditions affecting warranties:

Technology and BESS OEM dependent

- Annual energy throughput
- Number of cycles and DoD
- Peak DC charge / Discharge rate (C-rate)
- Maximum temperature
- Daily average DC charge / Discharge rate
- Maximum temperature deviations
- Average Rest SOC and rest periods
- Common mode noise level



MATCHING TECHNICAL DESIGN AND PERFORMANCE WITH BUSINESS MODEL

USABLE POWER AND ENERGY CAPACITY

- Ensuring the BESS system designed (and procured) can deliver requirements
- Early definition of standards (IEC 62933) and testing procedures for verification

AVAILABILITY

- Availability guarantee covering not only product availability but BESS system (energy), with proper formulation & reflecting O&M costs
- Energy availability in what concerns access and estimation of State of Charge (SoC)

BATTERY DEGRADATION

- Essential to have proper forecast of battery degradation over time considered and Performance warranties need to cover foreseen usage resulting from the business model
- Flexibility of warranted usage fundamental in current market stage and co-located projects

FINAL REMARKS

MITIGATING RISKS OF INTEGRATING BESS IS KEY TO FOSTER ADOPTION

Bureau Veritas, with the local knowledge and global footprint, is uniquely positioned to support renewable and BESS owners.

- Market in majority of Africa **present great potential**, which needs to be grasped from several perspectives.
- Achieving the required performance of BESS to support the business case needs **proper design and mitigation of risks** considering the **existing infrastructure and full lifecycle of the asset.**
- **De-risking BESS projects start from the design and procurement stages**. Early tackling key project risks contribute to easier, faster deployment, where safety and performance risks are tackled when they are cheaper and easier to solve.

29 GWh

BV has contributed to more than 29 GWh of BESS projects worldwide with a full range of services.

Q&A SESSION

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Shaping a World of Trust