LAPP ASIA PACIFIC WEBINAR SERIES 2020

HARNESSING THE POTENTIAL OF BATTERY ENERGY STORAGE SYSTEMS (ESS)

Presented by: Boon-Hong LEE & Terry KO
September 2020

The Speaker(s)

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Regional Product Marketing Manager

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Director, Head of Product Management & Development


1. WHAT IS AN ENERGY STORAGE SYSTEM (ESS)
2. KNOW THE ESS MARKET POTENTIAL
3. UNDERSTANDING ESS MARKET DRIVERS
4. MARKET CHALLENGES
5. ESS CABLE PRODUCT RANGE
6. TARGET APPLICATIONS
7. COMPLEMENTARY PRODUCTS
8. QUESTIONS & ANSWERS
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AN ENERGY STORAGE

IS THE CAPTURE OF ENERGY PRODUCED AT ONE TIME FOR USE AT A LATER TIME. A DEVICE THAT STORES ENERGY IS GENERALLY CALLED AN ACCUMULATOR OR BATTERY.

WIKIPEDIA

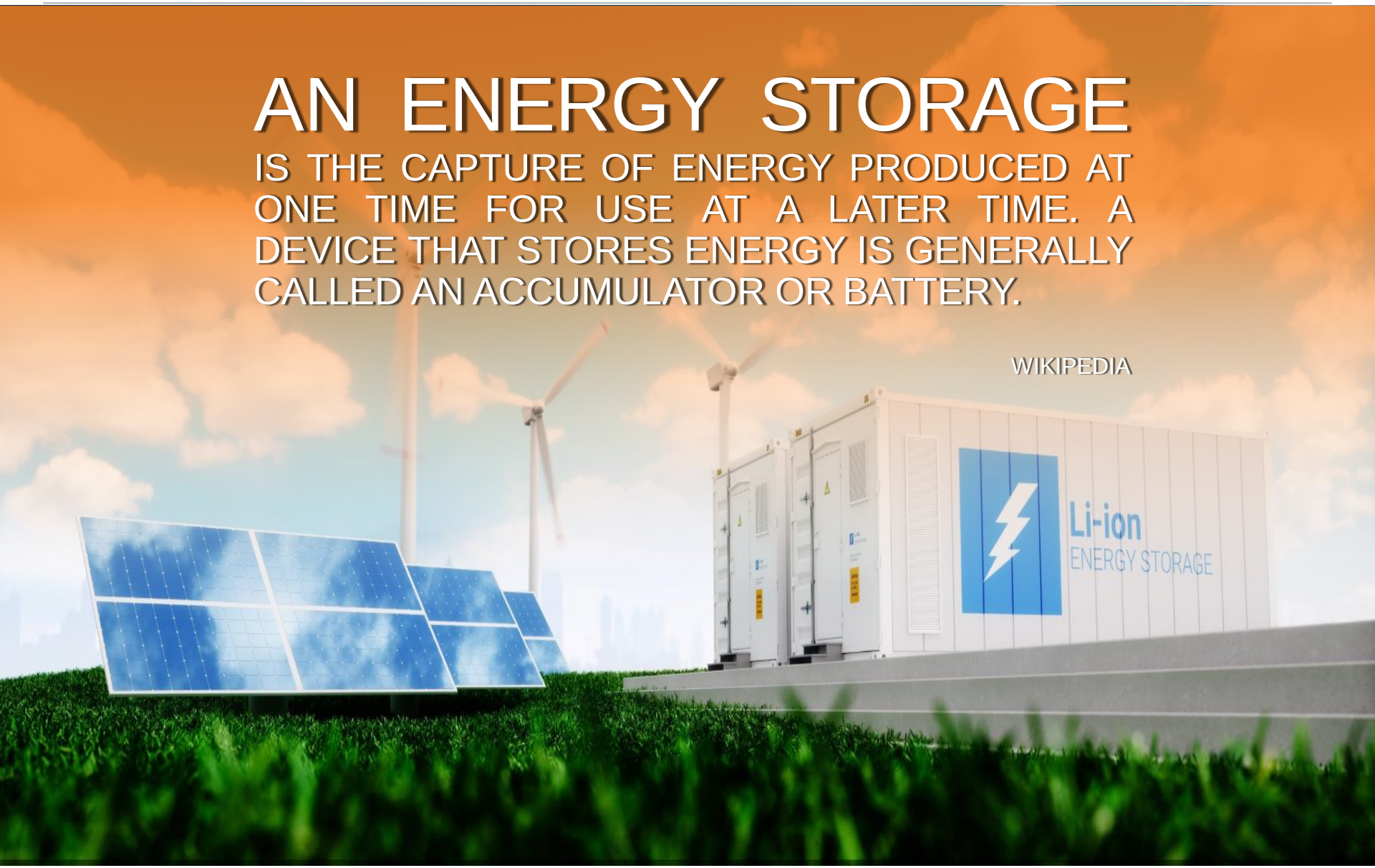


Image Source: petrmalinak/Shutterstock.com

ESS BRING MULTIPLE BENEFITS TO POWER SYSTEM AND CONSUMERS

Facilitate integration of distributed & intermittent generation sources

Shift peak load and arbitrage electricity prices

Provide ancillary services to market via regulation & reserves

Respond rapidly to power fluctuations within networks to ensure system stability & reliability

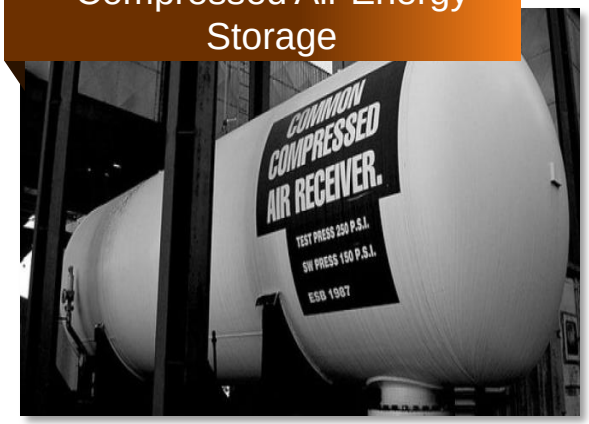
Image Source: petrmalinak/Shutterstock.com

“ENERGY STORAGE SYSTEM” STILL HAS A COMPLEX LANDSCAPE DEFINITION

TODAY WE FOCUS ON 2 SPECIFIC AREAS

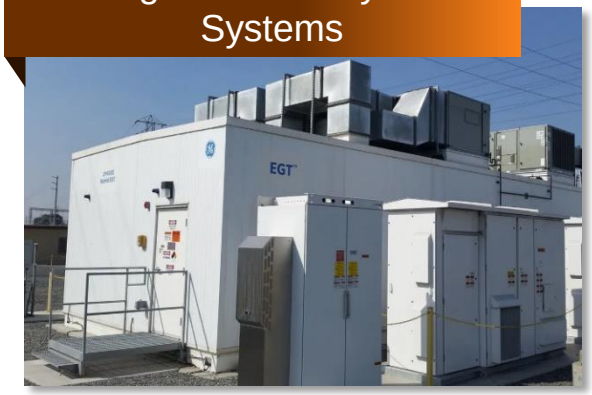
Electric Vehicles ESS

Compressed Air Energy Storage



Renewables Energy Storage

Large scale Utility Grid Systems



Flywheel Energy Storage

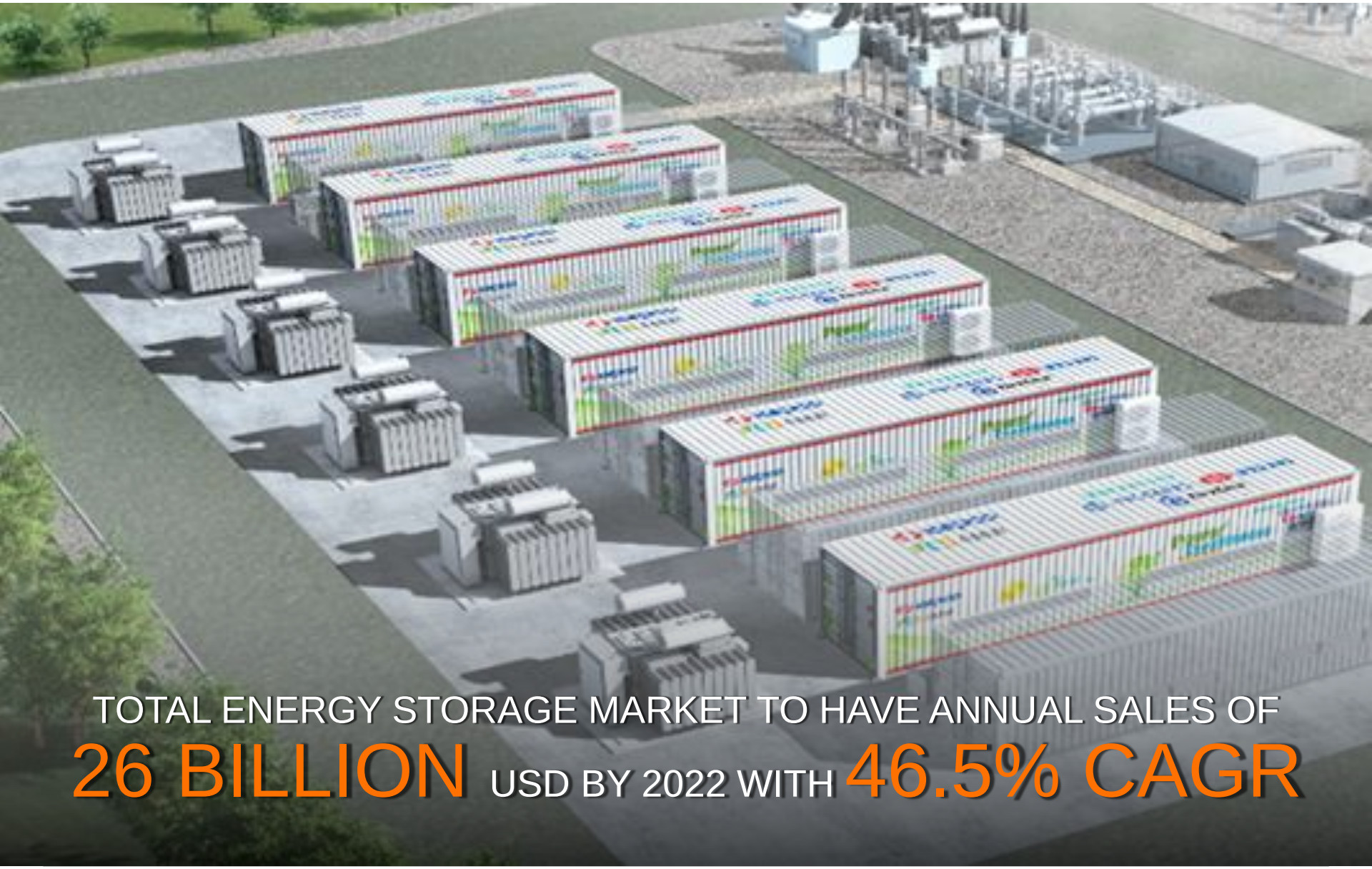
ESS – Battery Storage

Image Source: Unsplash, BBC, Delta Systems, NASA, US Power Utility

ASIA PACIFIC ACCOUNTED FOR THE LARGEST REGION IN GLOBAL ENERGY STORAGE MARKET

PNS MARKET RESEARCH

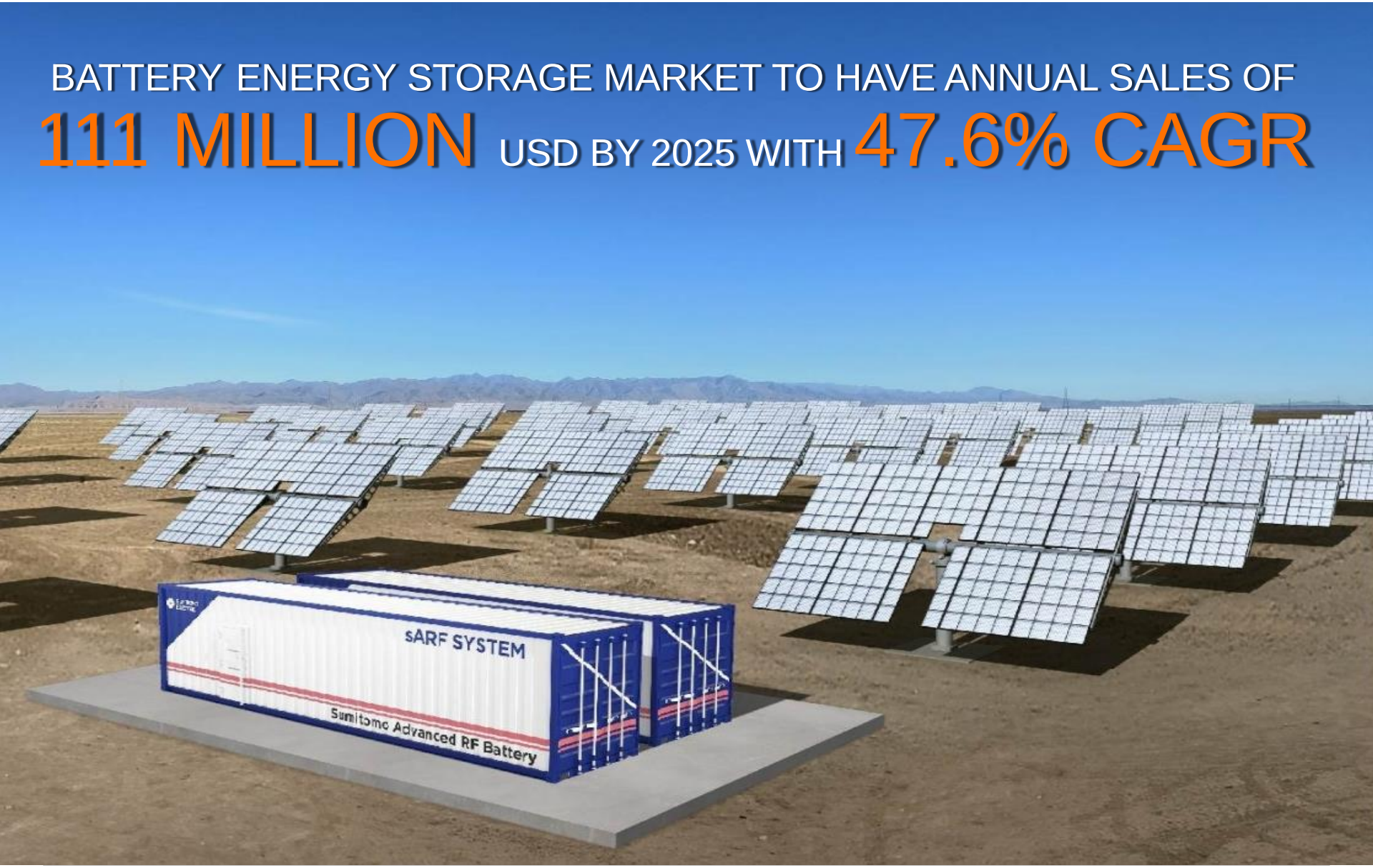
Quote Source: PNS Market Research 2019 Photo: JournalDiary.com



Figures Source: PNS Market Research, Photo: Hyosung Heavy Industries website, ESS containers

BATTERY ENERGY STORAGE MARKET TO HAVE ANNUAL SALES OF

111 MILLION USD BY 2025 WITH 47.6% CAGR



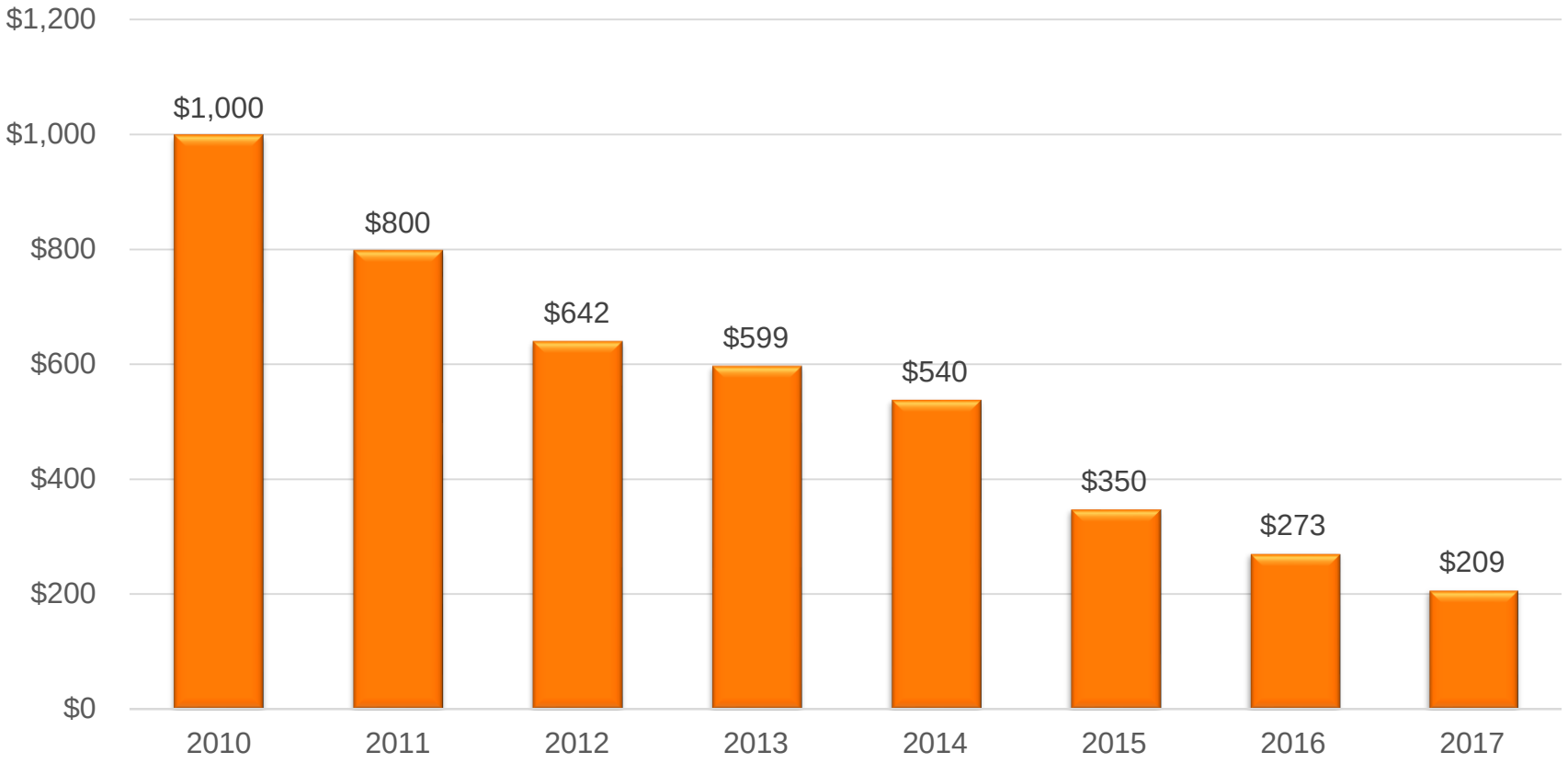
Report source: wiseawareness.com/exclusive-report-on-global-battery-energy-storage-system-market-2025, Image Source: Sumitomo Electric Industries

MARKET LEADERS IN THE BATTERY ENERGY STORAGE MANUFACTURING SEGMENT

UNDERSTAND THE MARKET DRIVERS & CHALLENGES IN BATTERY ENERGY STORAGE

Photo: GE Energy

LITHIUM PRICES TREND IN THE LAST 8-9 YEARS MAKES IT A LEADING TECHNOLOGY OF CHOICE FOR BATTERY ESS



Source: Bloomberg New Energy Finance, Lithium-ion Battery Price Survey

Sources: DeLoitte – Supercharged challenges and opportunities in global battery markets report 2019

VISIBLE MARKET DRIVERS AND TRENDS IN BATTERY ESS

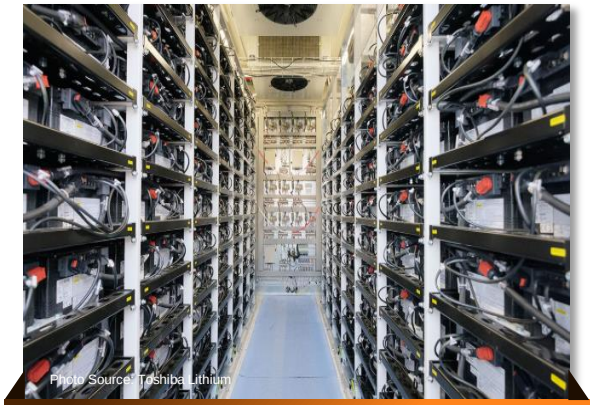


Photo Source: Toshiba Lithium

Lithium-ion becomes technology of choice for solar-based ESS

Photo Source: Tesla Power

Grid modernization

Photo Source: Unsplash

Global movement towards renewables

Photo Source: Unsplash

Government-sponsored financial incentives

Photo Source: Samsung SDI website

Residential ESS growth may outstrip utility-scale

Photo Source: Unsplash

Mandatory policies linked to quality-of-life and urbanization goals

Sources: DeLoitte – Supercharged challenges and opportunities in global battery markets report 2019

MARKET CHALLENGES IN BATTERY ESS THAT WE SHOULD BE AWARE OF

Lack of standardization

Incomplete definition of battery energy storage

Outdated regulatory policy and market design in countries

Sources: DeLoitte – Supercharged challenges and opportunities in global battery markets report 2019, LAPP customer visits in Korea

ESS CABLE PRODUCT RANGE

ÖLFLEX®
DC ESS SC

Description

- Single core cable for ENERGY STORAGE SYSTEM (ESS) applications
- Nominal voltage: **DC 1500V** designed acc. to EN 50618
- Cross sections: From 1.5 mm² **to 300 mm²**
- Fire behaviour according to EN and IEC standards:
  - ✓ **Highly flame retardant** acc.to IEC60332-3
  - ✓ Highly smoke density acc.to IEC60134
  - ✓ Highly halogen free and toxicity acc.to IEC60754

** Oil and fuel resistant
** **HEAT resistant**
** **Ozone / Weather / UV resistant**
** **Flexibility** – to bend the cores into tight and narrow spaces

Application

- Use in ESS, for fixed installations and applications where limited movement may occur
- Internal wiring of electrical equipment
- External wiring container to container
- Potential Customers: LG CHEM, SAMSUNG SDI, SK INNOVATION, POSCO ICT, WOOJIN, Kokam, etc

Benefits

- **High flexibility**
- **High fire safety**
- Wide operating temp. range **-40℃ to 125℃**

Availability

- All size of cables are ready to delivery

ÖLFLEX®
DC ESS SC A

Description

- Single core cable for ENERGY STORAGE SYSTEM (ESS) applications acc. to **UL44 RHW-2**
- Nominal voltage: **AC 2000 V** designed acc. to UL44 RHW-2
- Cross sections: From 1.5 mm^2 **to 300 mm^2**
- Fire behaviour according to EN and IEC standards:
  - ✓ **Flame retardant** acc.to VW1, FT4
  - ✓ Smoke density acc.to IEC61034
  - ✓ Halogen free acc.to IEC60754

** **Ozone / Weather / UV resistant**

Application

- Use in ESS, for fixed installations and applications where limited movement may occur
- Internal wiring of electrical equipment
- External wiring container to container
- Potential Customers: LG CHEM, SAMSUNG SDI, SK INNOVATION, POSCO ICT, WOOJIN, Kokam, etc

Benefits

- **UL certification**
- **High fire safety**
- Wide operating temp. range -40℃ to UL 90℃ wet or dry

Availability

- All size of cables are ready to delivery

South Korea Identifies Top 4 Causes that Led to ESS Fires

By Steve Cummings

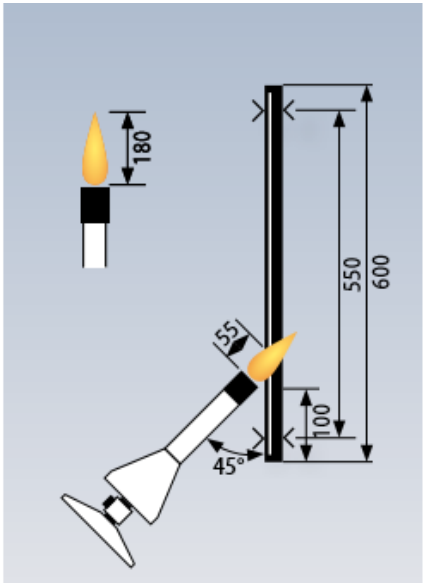
Insufficient battery protection systems against electric shock
Systems were not able to properly protect against electrical hazards due to ground faults or short circuits. When large electrical surges were imposed on the battery system the fuse was not able to quickly interrupt the current which led to catastrophic failure of the contactors. The short circuit current allowed the failures cascade to the bus bar which resulted in fires inside the ESS. This failure mode was confirmed by the committee during their fire accident investigation.

Inadequate management of operating environment
Of the 23 fire incidents that occurred, 18 were installed in the mountains or coastal areas. It was concluded that these environments resulted in harsh conditions including large temperature swings, high humidity and elevated levels of dust and particulates which ultimately led to failure modes resulting in fires. The elevated humidity levels and large temperature swings resulted in condensation, and resulting residue after drying, within the battery system. This effect was determined to degrade the electrical insulation inside the battery modules between the cells and module ground which resulted in short circuits and subsequent fires. This cause was believed to be made worse by modules fans designed to air-cool the battery modules.

Faulty Installations
It was determined that human error during installations can also lead to system faults resulting in ESS fires. Not many details were provided by the investigation committee, but cases such as faulty wiring or mechanical damage to the batteries during installation were sited.

ESS System Integration
The integrated protection and management systems were found to be insufficient with the ESS. It was confirmed by the committee that gaps in the integration of the battery management system (BMS), energy management system (EMS), and power management system (PMS) can result in conditions that lead to fire. Integration issues included inadequate information sharing between systems, system operating sequence, and checking for abnormalities of the batteries after PCS maintenance or troubleshooting.

TESTING METHOD - FOR FIRE PERFORMANCE OF CABLES



1.1 IEC 60332-1-2 / EN 60332-1-2 / VG 95218-2 Method 1 / BS 4066 Part 1 / VDE 0482-332-1-2

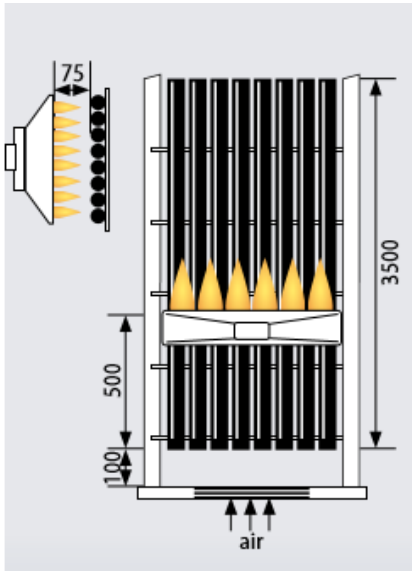
Test set-up	The single cable under test is secured vertically and flamed with a burner at an angle of 45° to the vertical. Test apparatus acc. to IEC / EN 60332-1-1.		
Flame temperature	Determined by the stipulated setting of the burner flame.		
Test duration	Cable with a diameter of	$D \leq 25$ mm:	60 ± 2 sec
	Cable with a diameter of	$25 < D \leq 50$ mm:	120 ± 2 sec
		$50 < D < 75$ mm:	240 ± 2 sec
		$D > 75$ mm:	480 ± 2 sec
Compliance criterion	The fire damage must end at least 50 mm below the upper fixing clamp. The cable must be self-extinguishing.		

PVC	✓
Rubber	✓
XLPO	✓

1.7 IEC 60332-3 / EN 60322-3 / VDE 0482-332-3

Test set-up	The cables are secured to a ladder, close together or spaced apart depending on the type of fire. The cables can be secured in several layers. Test apparatus acc. to IEC / EN 60332-3-10.	
Flame temperature	Determined by the stipulated quantity of propane gas and air.	
Test duration	IEC Part 21/EN Part 21: Category A F/R for special applications only	
	IEC Part 22/EN Part 22: Category A (7 l flammable material/m):	40 min
	IEC Part 23/EN Part 23: Category B (3.5 l flammable material/m):	40 min
	IEC Part 24/EN Part 24: Category C (1.5 l flammable material/m):	20 min
	IEC Part 25/EN Part 25: Category D (0.5 l flammable material/m):	20 min
Compliance criterion	The visible area of fire damage to the cables must not exceed 2.5 m in height from the bottom edge of the burner.	

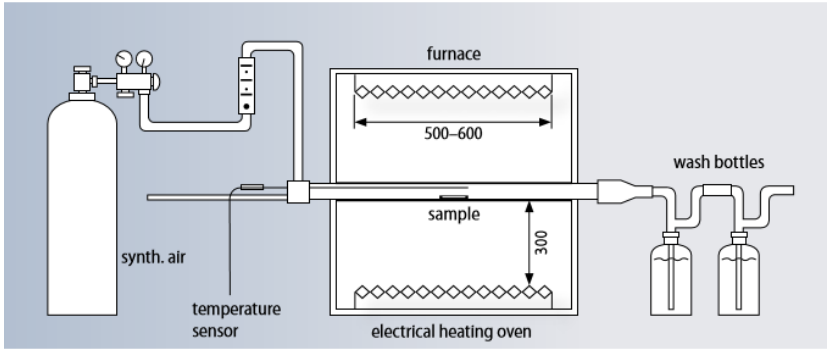
PVC	✓
Rubber	✗
XLPO	✓



TESTING METHOD - FOR FIRE PERFORMANCE OF CABLES

4.1 IEC 60754 / EN 50267 / VDE 0482-267-1 / NF C32-074

Test set-up	This standard covers the general aspects of corrosiveness of smoke and combustion gases dissolved in water or atmospheric moisture as well as the potential hazard (general guidelines).



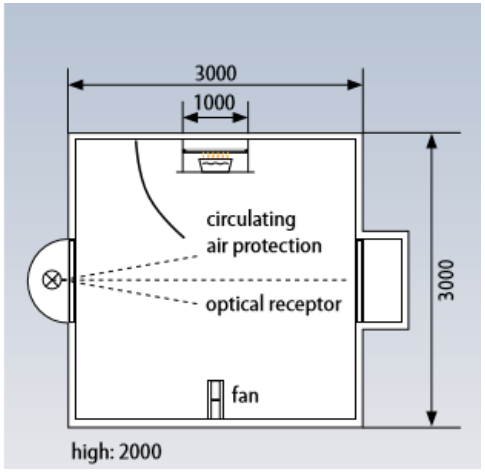
4.2 IEC 60754-1 / EN 50267-2-1 / VDE 0482-267-2-1 / NF C32-074-21

Test set-up	A sample of between 0.5 g and 1.0 g is heated in a tube. The resulting gases are dissolved and tested for their halogen content. Test apparatus acc. to EN 50267-1.
Flame temperature	800 ± 10 °C
Test duration	40 ± 5 minutes in total, with at least 20 minutes at the maximum temperature
Compliance criterion	The amount of halogen acid is expressed as mg of hydrochloric acid per gramm mass of sample
Scope	For compounds or materials described as "zero halogen" and all materials containing less than 5 mg/g halogen acid equivalent, it is recommended to use the method specified in IEC 60754-2/EN 50267-2-2.

PVC	✘
Rubber	✘
XLPO	✓

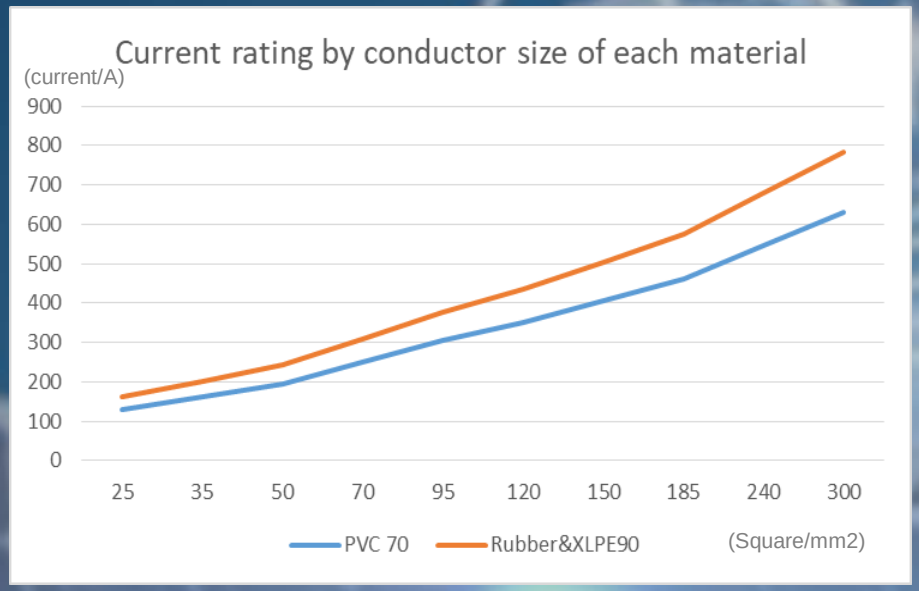
2.1 IEC 61034-2 / EN 61034-2 / VDE 0482-1034-2 / NF C32-073-2

Test set-up	A cable specimen is burnt in a closed chamber using a flammable liquid. The light transmittance of the resulting smoke is measured optically. Test apparatus acc. to IEC/EN 61034-1
Flame temperature	Determined by the quantity and composition of the fuel.
Test duration	40 min
Compliance criterion	The smoke must transmit the light at the end of the test's duration, as stated in individual specifications. The recommendation of light transmission is 60 % minimum.

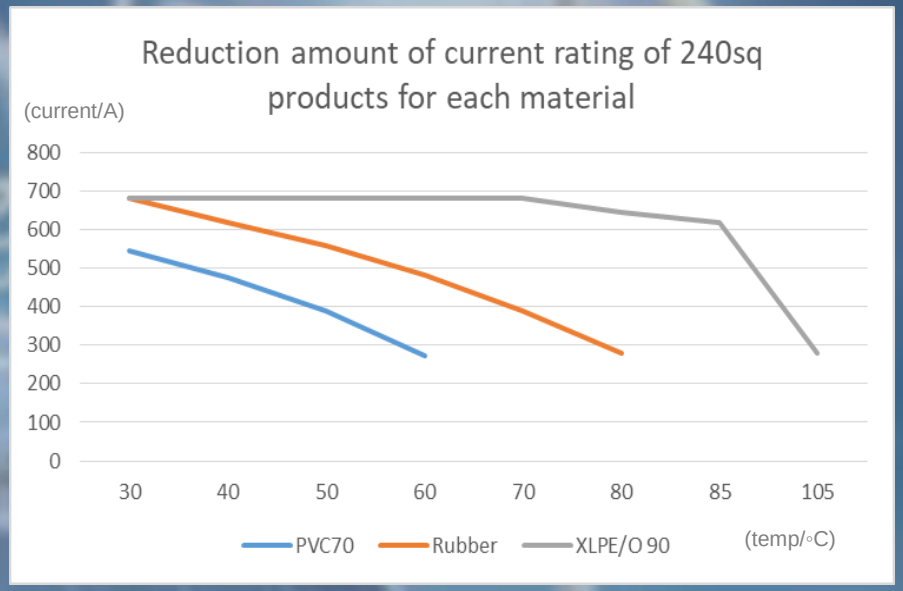


PVC	✘ | partly
Rubber	✘
XLPO	✓

Material-based power efficiency
Rubber & XLPO > PVC



Heat-based power efficiency
XLPO > Rubber ≥ PVC



installation method - table A.52-1 - Two loaded conductors touching (Method F) acc.to IEC60464-3-52 & VDE0298-4 2013-06 table18

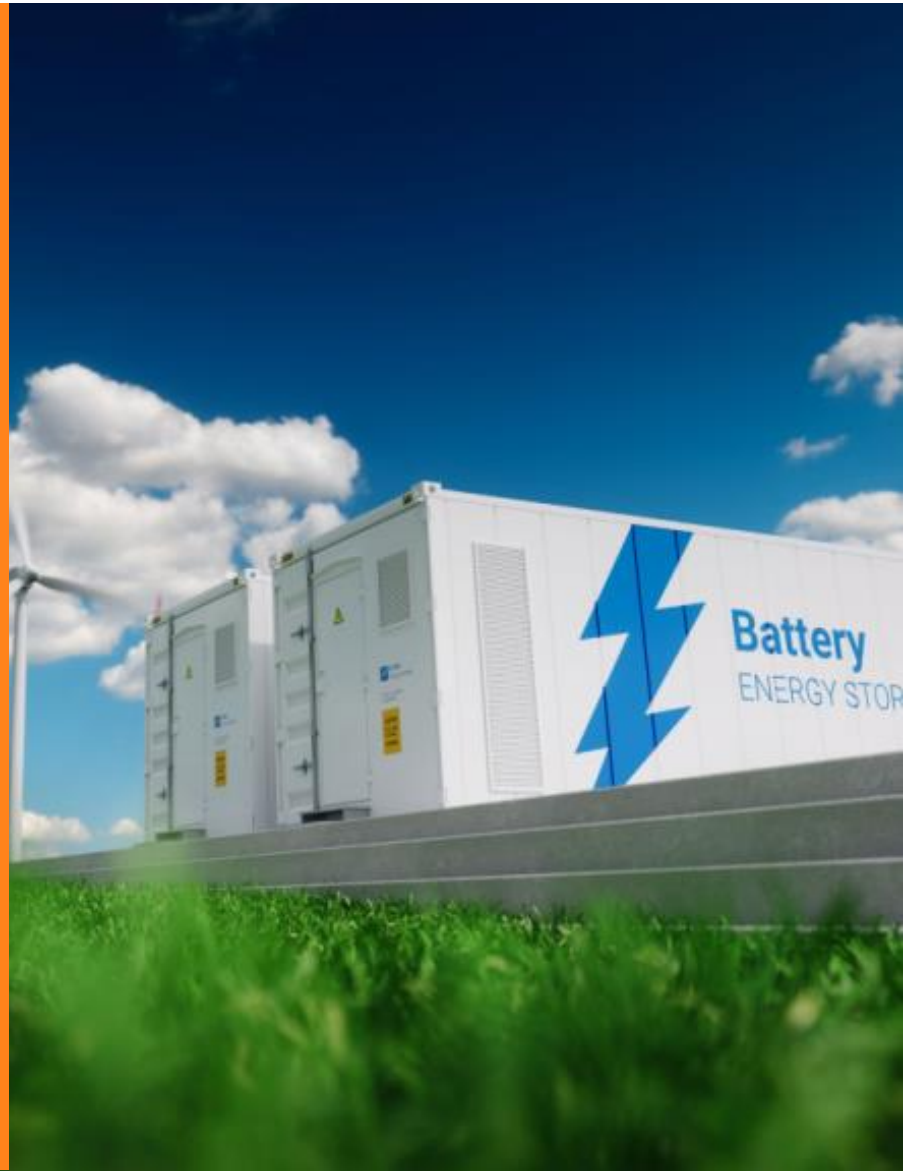
Comparison table for ESS Main power line

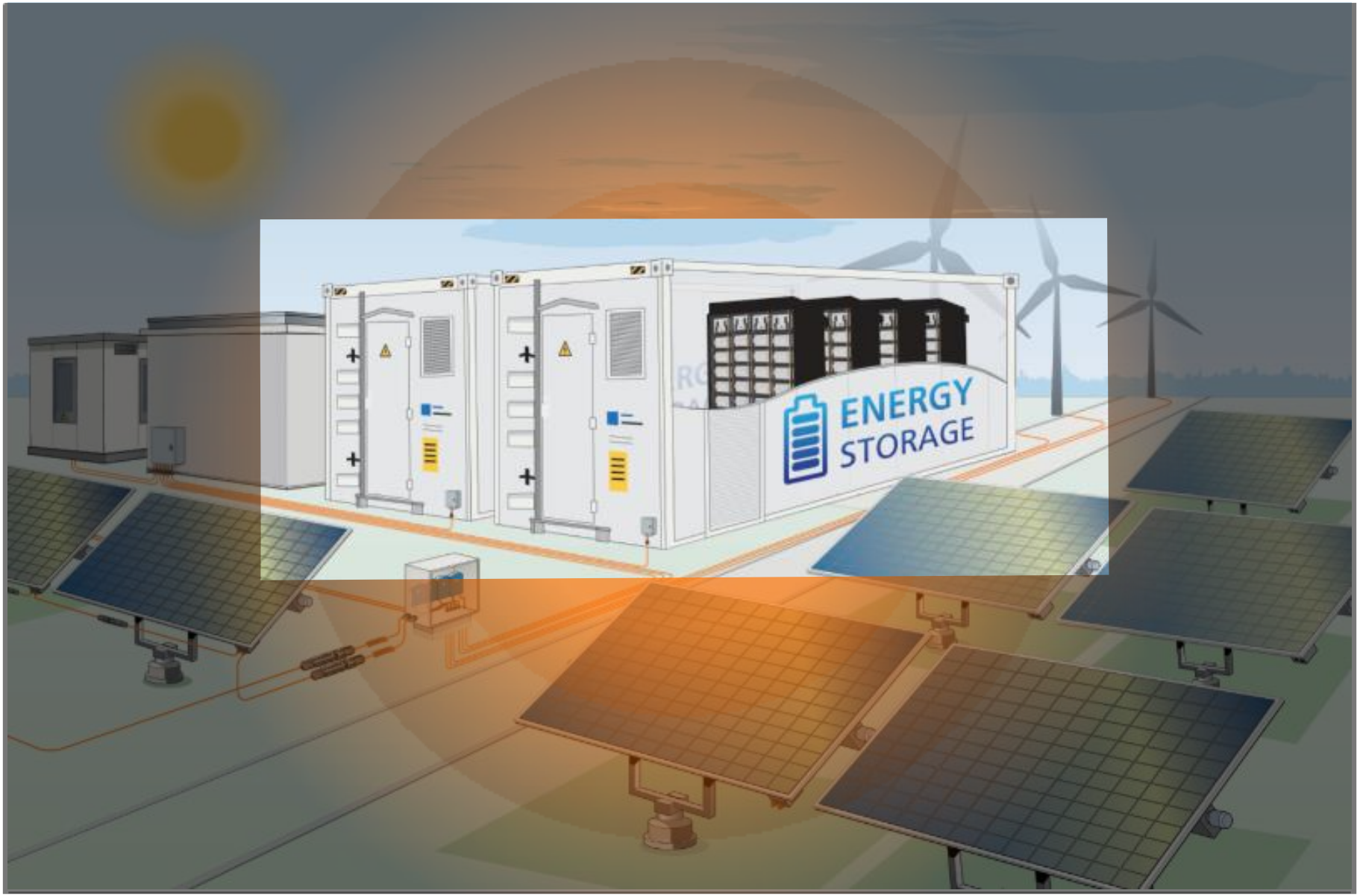
	DC ESS SC	DC ESS SC A	L company (Korea)	K company (Korea)	NSGAFOU (LAPP | Nexans | Prysmian etc)	Remark
Standard for product	EN 50618	UL44 RHW-2 (UL AWM)	NF F 63-826	KIS-ES-4002	VDE 0250-602	
Application of standard	Renewable energy	Renewable energy	General purpose	Railway	General purpose	
Voltage	**DC 1500 V Max. DC 1800 V**	2000 V	DC 1500 V	AC 1500 V	AC 1800 V	
Conductor current rate	**120°C**	90°C	90°C	110°C	90°C	
Outer diameter	**28.6mm (240sq)**	**28.6mm (240sq)**	Max 29.1mm (240sq)	Max 31.0mm (250sq)	34.5mm (240sq)	
Life time	**120°C 20,000hr**	-	-	-	-	
Low temperature performance	-40°C	-40°C	-25°C	-	-40°C	
Outdoor installation	UV Ozone resistant	UV	Ozone resistant	-	-	
Material	• E-Beam cross linked • Halogen free FR polyolefin	• Moisture curing cross-linked • Halogen free FR compound	EVA	FR cross-linked PE	Rubber	
Flame retardant	**IEC 60332-3-24**	**UL FT4, VW-1**	**IEC 60332-3-24**	No data (FR cable)	IEC 60332-1-2 Single wire burring	
Catalogue / datasheet		Under development				

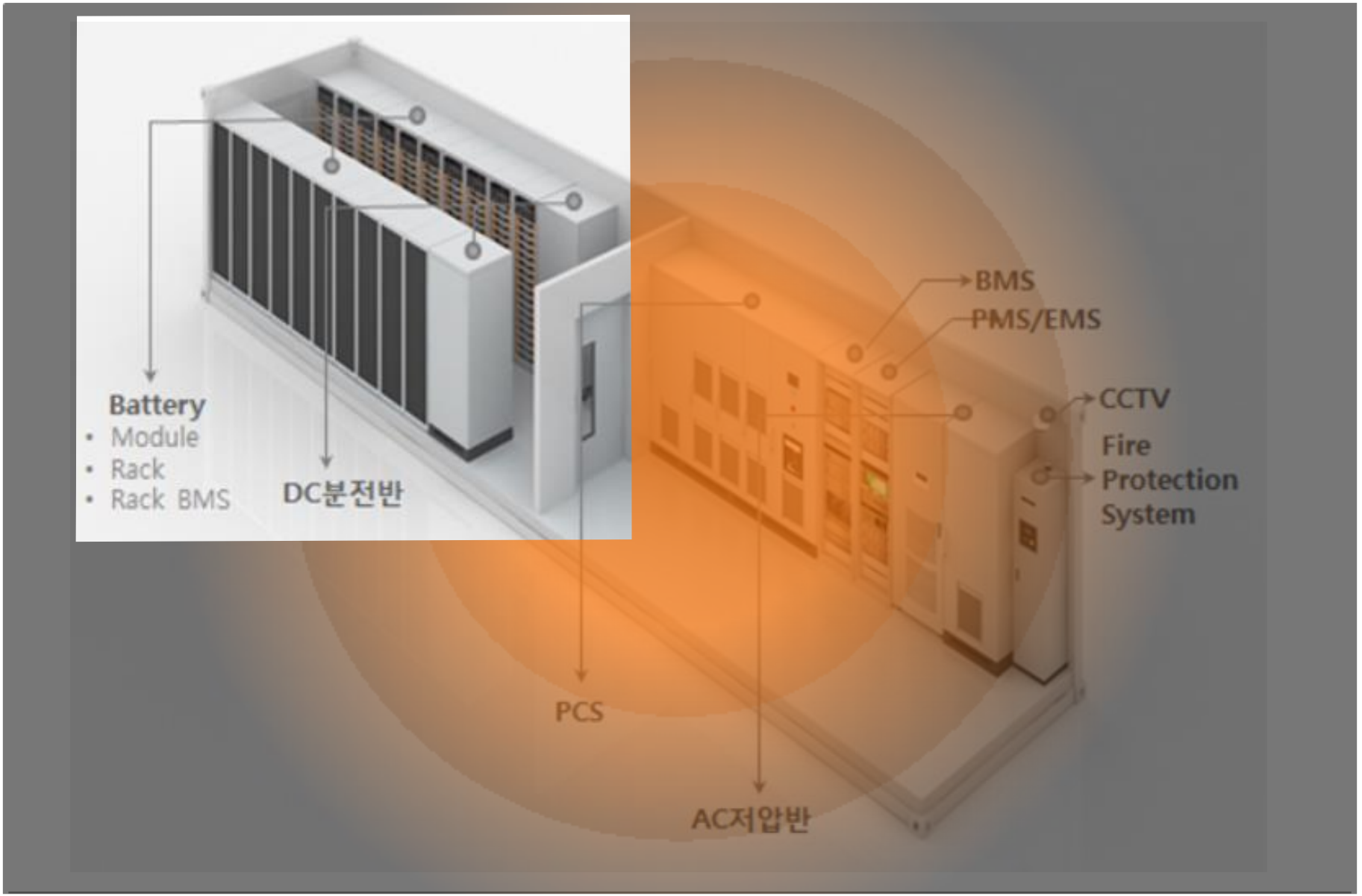
	For main power line purpose : Selection table of LAPP products					
	N2XY	NSGAFOU	SOLAR XLR-E	SOLAR XLWP	DC ESS SC	DC ESS SC A
Voltage	1.8/3kV AC	1.8/3kV AC	DC1500V	DC1500V	DC1500V	2000V AC
Insulation resistance	★★★★	★★★	★★★	★★★	★★★★	★★★★
Heat resistance	★★	★★	★★★★	★★★★	★★★★	★★★
Outer diameter	★★	★	★★★	★★★	★★★	★★★
Bending radius	★	★★★	★★★	★★★	★★★★	★★★
Flexibility	★	★★★	★★	★★	★★★★	★★
Fire performance	★★	★★	★★★	★★★	★★★★★	★★★
Cost Effectiveness	★★★★★	★★★	★★★	★★★	★★	★★
Remark	Cheap and general purpose	Heavy duty purpose	For solar	Water resistant Direct burial	Extreme performance	For US market (UL)

*LAPP has a wide range of cables for power applications

TARGET APPLICATIONS




ENERGY
STORAGE


Battery
• Module
• Rack
• Rack BMS
DC분전반
BMS
PMS/EMS
CCTV
Fire
Protection
System
PCS
AC저압반

ESS (Energy Storage System) | Types of Batteries

Battery manufacturer status by type

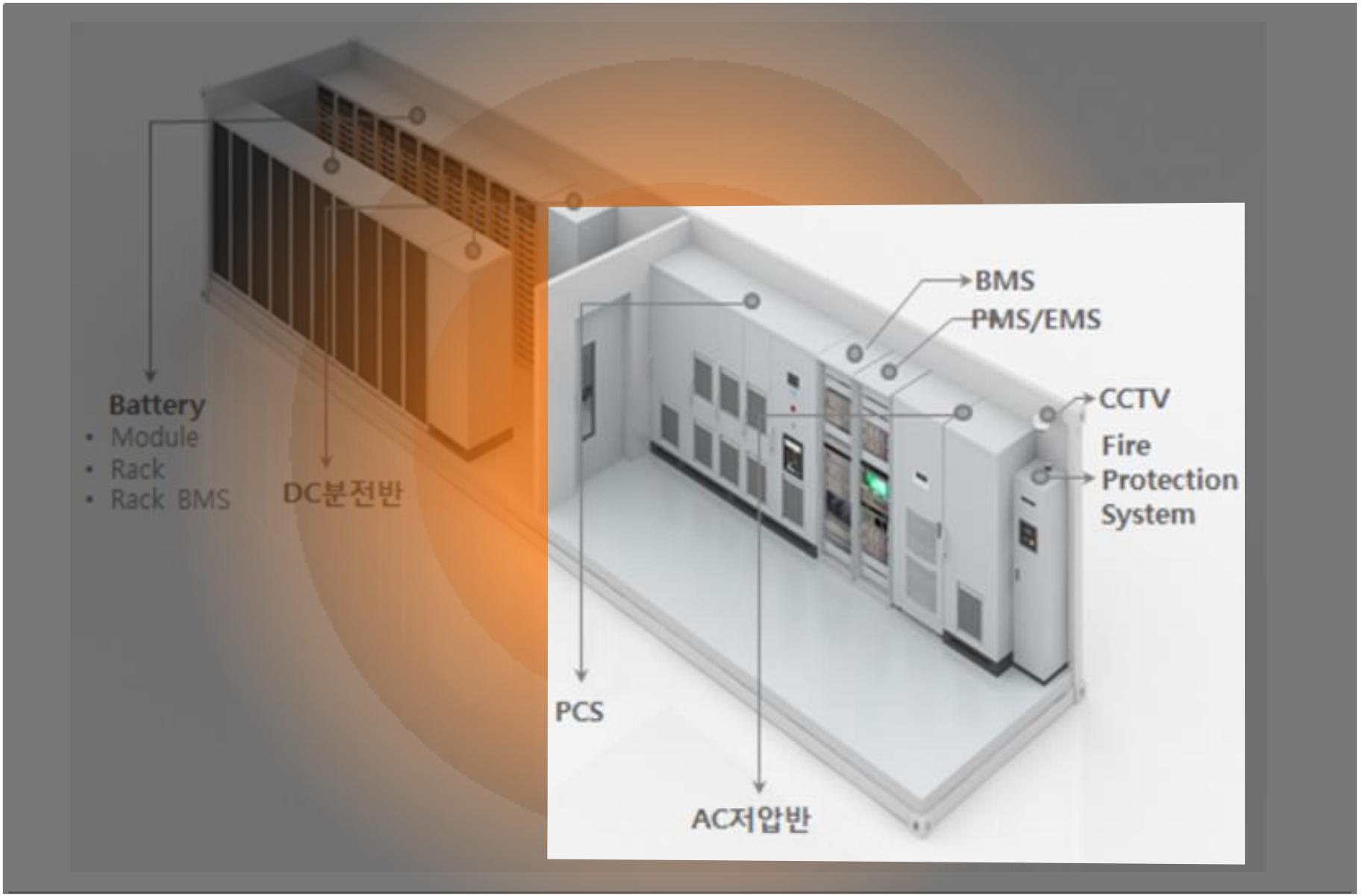
Lithium-ion Battery	LG Chem | Samsung SDI
Lithium Polymer Battery	SK Innovation | Kokam
Lead Acid Battery	Separate Battery
Other Companies	Lotte Chemical (CFB, chemical flow battery) OCI (Developing new technology battery -VRFB)

Products in the battery rack

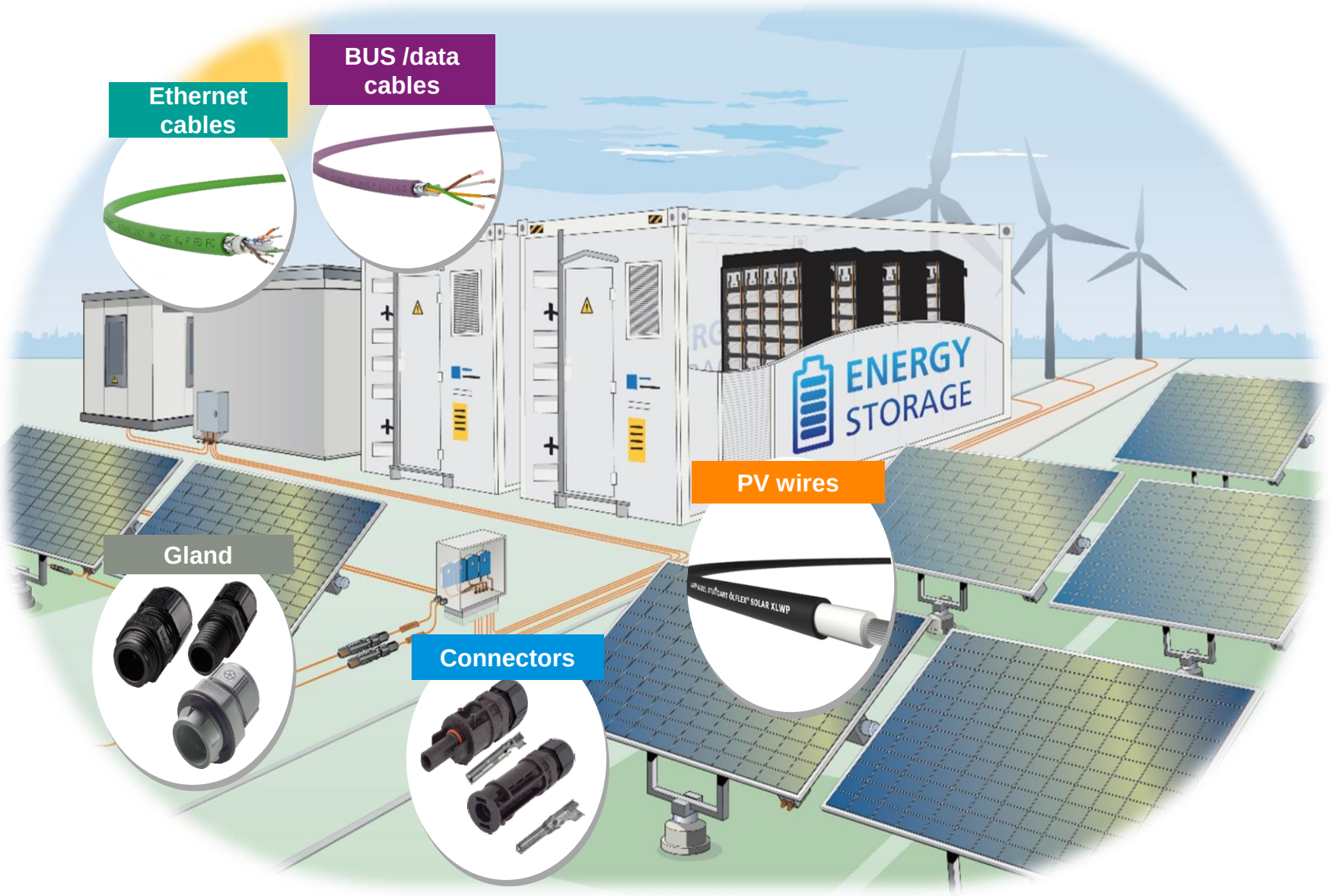
- Battery
- Air conditioner (fan to cool when overheated)
- 24V DC motor
- **Battery connection cable (single core 25,50SQ),** cable lug
- Battery rack, cable gland

Rack to rack

- **Rack connection cable (single core 95sq mostly),** cable lug


Battery
• Module
• Rack
• Rack BMS
DC분전반
BMS
PMS/EMS
CCTV
Fire
Protection
System
PCS
AC저압반

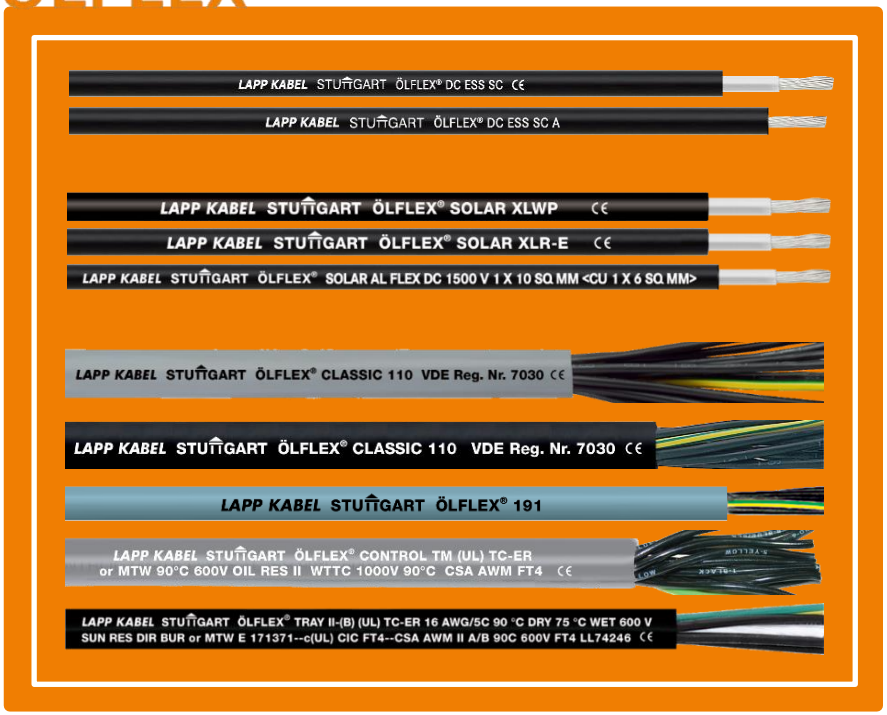
COMPLEMENTARY PRODUCTS


Ethernet cables
BUS /data cables
ENERGY STORAGE
PV wires
Gland
Connectors

ONEASIA

LAPP

ÖLFLEX®



ETHERLINE®

UNITRONIC®

EPIC®

SKINTOP®

ACCESSORIES

ÖLFLEX® Solar XLR-E

Cross-linked solar cables – type H1Z2Z2-K certified according to EN 50618

ÖLFLEX® Solar XLR-E T

Electron beam cross-linked solar twin-cables, separable – EN 50618 type

Solar Connectors

KT Cable Shears

KNIPEX ratchet shears for conductors with an outer diameter of up to 60mm, ergonomic design, made in Germany

Benefits

- One-hand operation through ratchet principle
- High ergonomics thanks to multi-component handles
- Insulated handles allow working under voltage up to 1000V

Application range

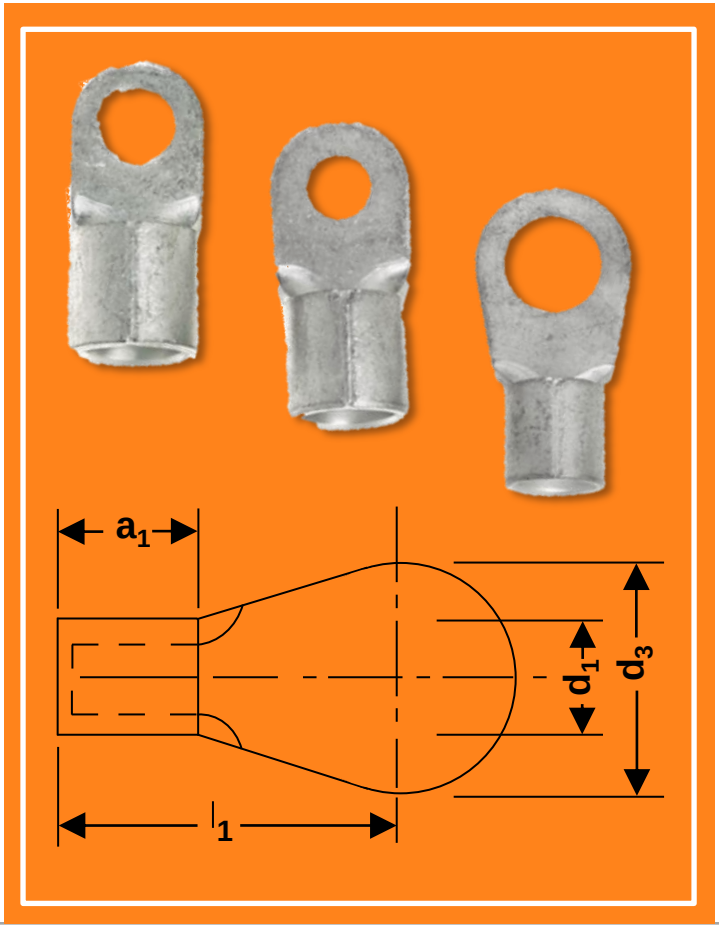
- Cuts copper and aluminum cables
- Not suitable for steel wire and wire ropes

Product features

- Precision ground, hardened blades
- Swivel knife can be unlocked in any cutting position with a press of the thumb

Solderless Cable Lugs KB

Uninsulated cable lugs/solderless terminals according to DIN 46234, high-quality electrolytic copper for good conductivity, least resistance



Benefits

- For first-class connection with simple operating principle
- Thus providing the best electrical conductivity (least resistance)

Application range

- For cables with category 2,5 and 6 conductors
- Manufacturing of control cabinets and equipment
- Trains and buses

Norm references or approvals

- In accordance with VG 88710
- Coil form DIN 46234

Shrink tube PROTECT-M/PROTECT-T

A 3:1 thick/medium walled shrinking tube, designed specifically for demanding environments such as underwater and underground applications.

Benefits

Medium / thick-walled

Application range

- For cables with category 2,5 and 6 conductors
- Manufacturing of control cabinets and equipment
- Trains and buses

Norm references or approvals

- In accordance with VG 88710
- Coil form DIN 46234

PVX 1300 pressing pliers battery-operated

For cable lugs. *NEW*: two-stage DUAL crimping technique (first hexagonal pressing, then additional mandrel pressing)

Benefits

- Pressure strength control using pressure monitoring
- Buzzing signal and flashing light if right pressure is not achieved
- Display with information on the tool and service interval
- Single-handed operation for easy handling
- Rapid feed for more efficient crimping

Application range

- Battery powered crimp tool for crimping of CU terminals KRF/KRT 10-400 mm^2
- Same accessories as V1311-A pliers

Product features

- Crimps/charge: 60-120 depending on size and temperature
- Battery type: Makita 5 Ah
- Charging time: 40 min

THANK YOU