

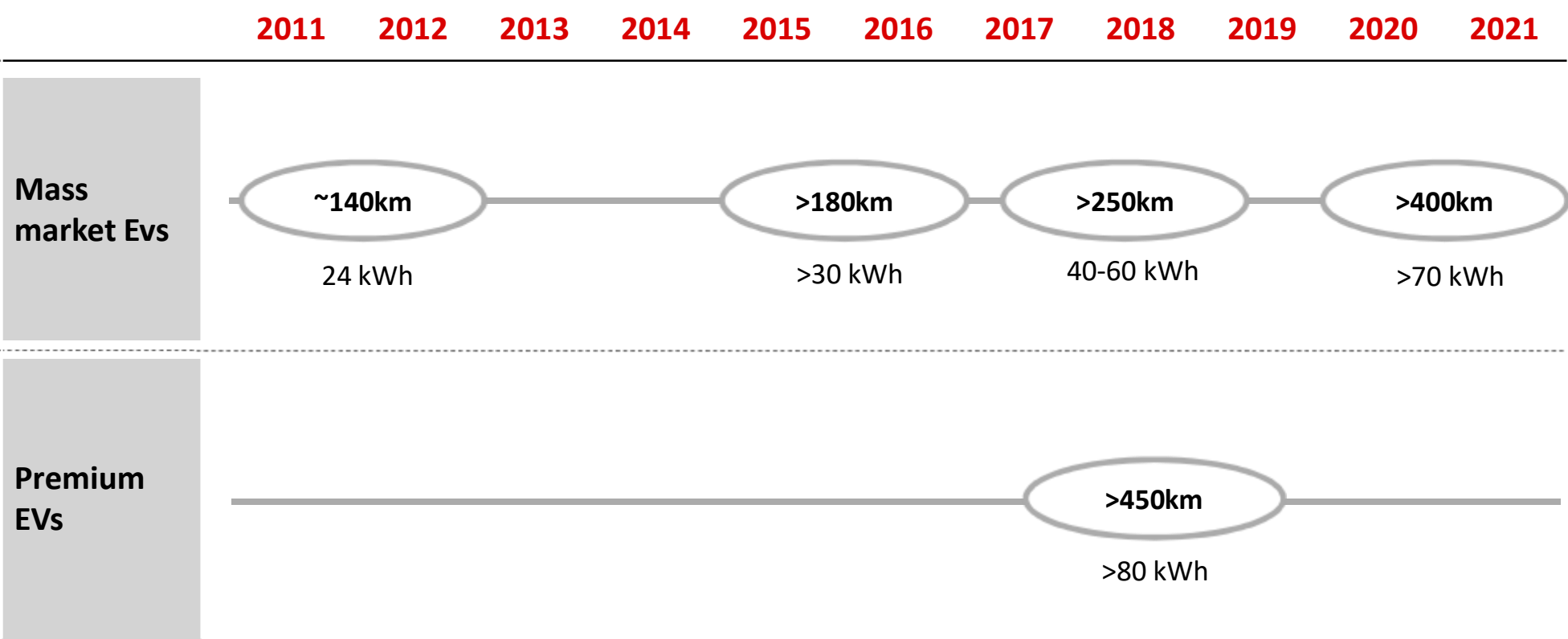


David Zonis, ABB

## **BESS (Battery Energy Storage System) for EV Charging Station**

Integration of fast/high power charging

Driver: Batteries get bigger, range gets longer, charging power increases



Small cars:  
50 - <150 kW







Mid/ high segment:  
120 - 150 kW



Top segment:  
~300/350 kW



# Public and commercial car charging – use cases

Public and commercial EV Charging			
Home & Work	Parking	Commercial	Highway
3-22 kW (AC)	20 kW (DC)	50 KW (DC)	150 to 350kW+(DC)
4-16 hours	1-3 hours	15-60 min	5-20 min
			

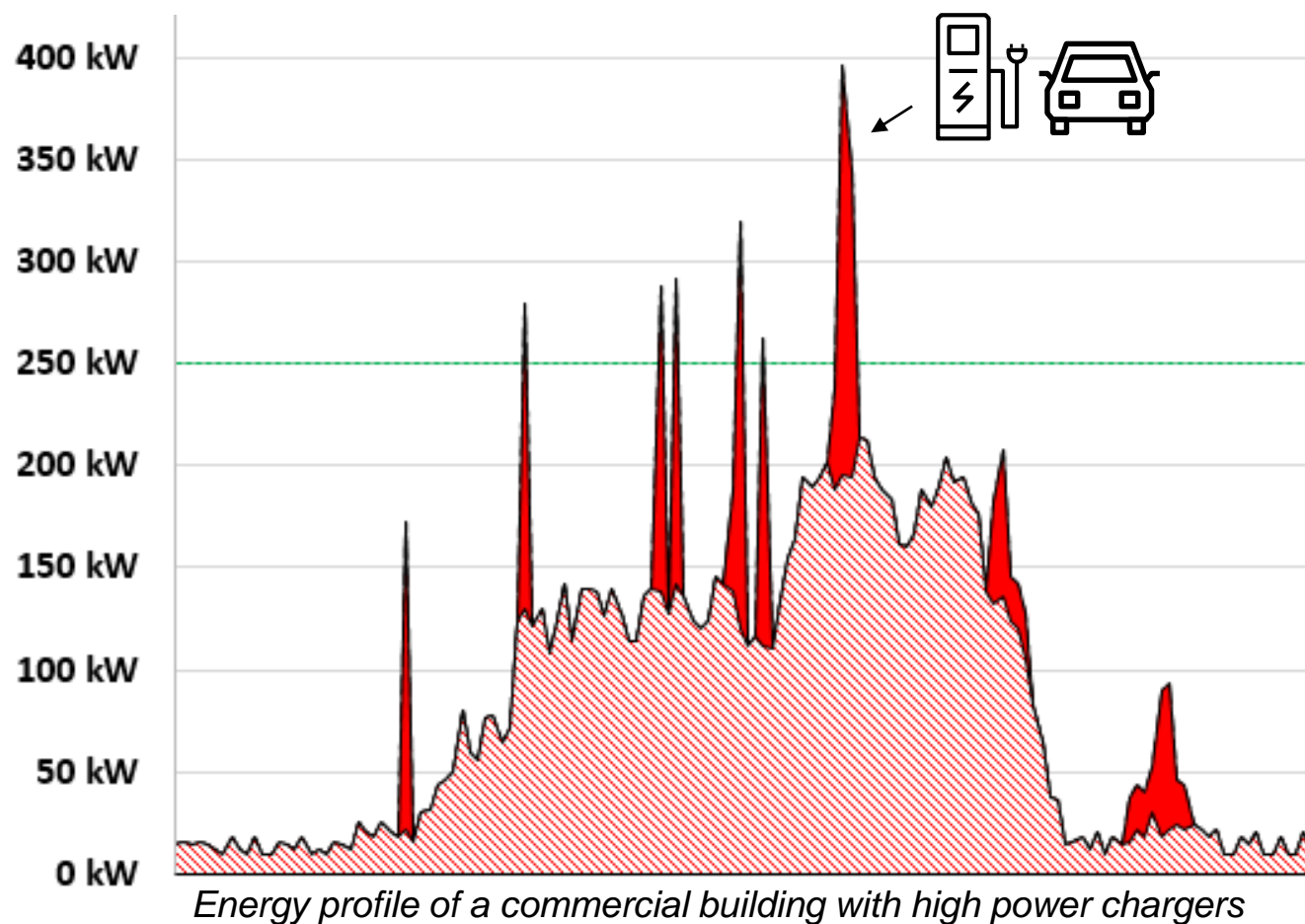
Variance among power and charge times are related to variables in vehicle capabilities (charging protocol, BMS, environmental), battery capacity (state of charge, overall kWh capacity) and charging hardware power rating. Level 1 AC charging at 1kW or less is not included in this chart as is limited for most public, commercial or fee-based charging applications.

## 4 – Behind the meter - Integration of EV charging Impacts on a C&I site

High power charging session generate **peaks of consumption** higher than site and grid connection capabilities

2 solutions:

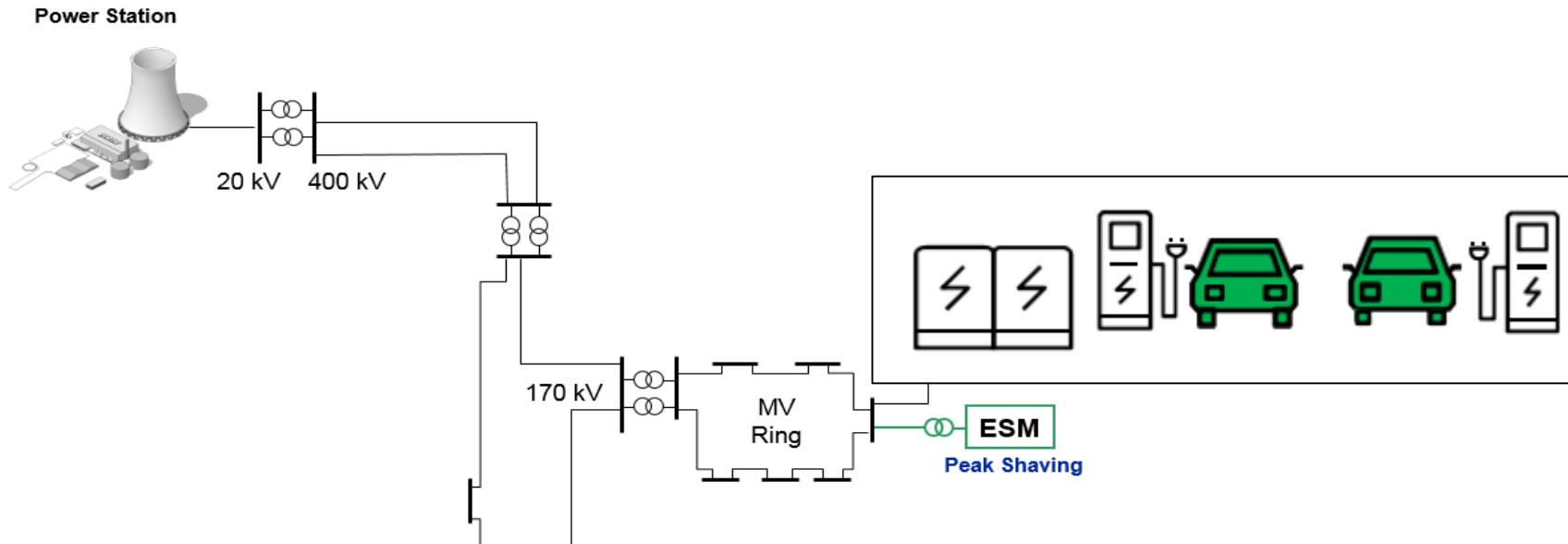
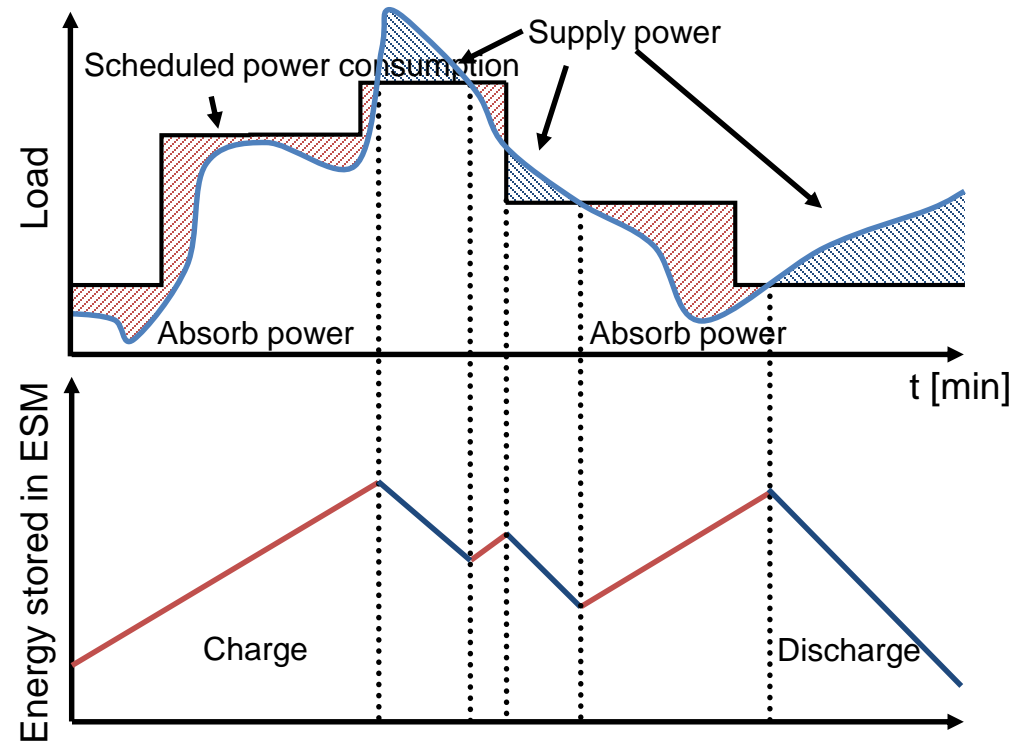
- Option 1 – **Upgrade site electrification & grid connection** (LV => MV)
- Option 2 – **Battery energy storage systems**



# Applications

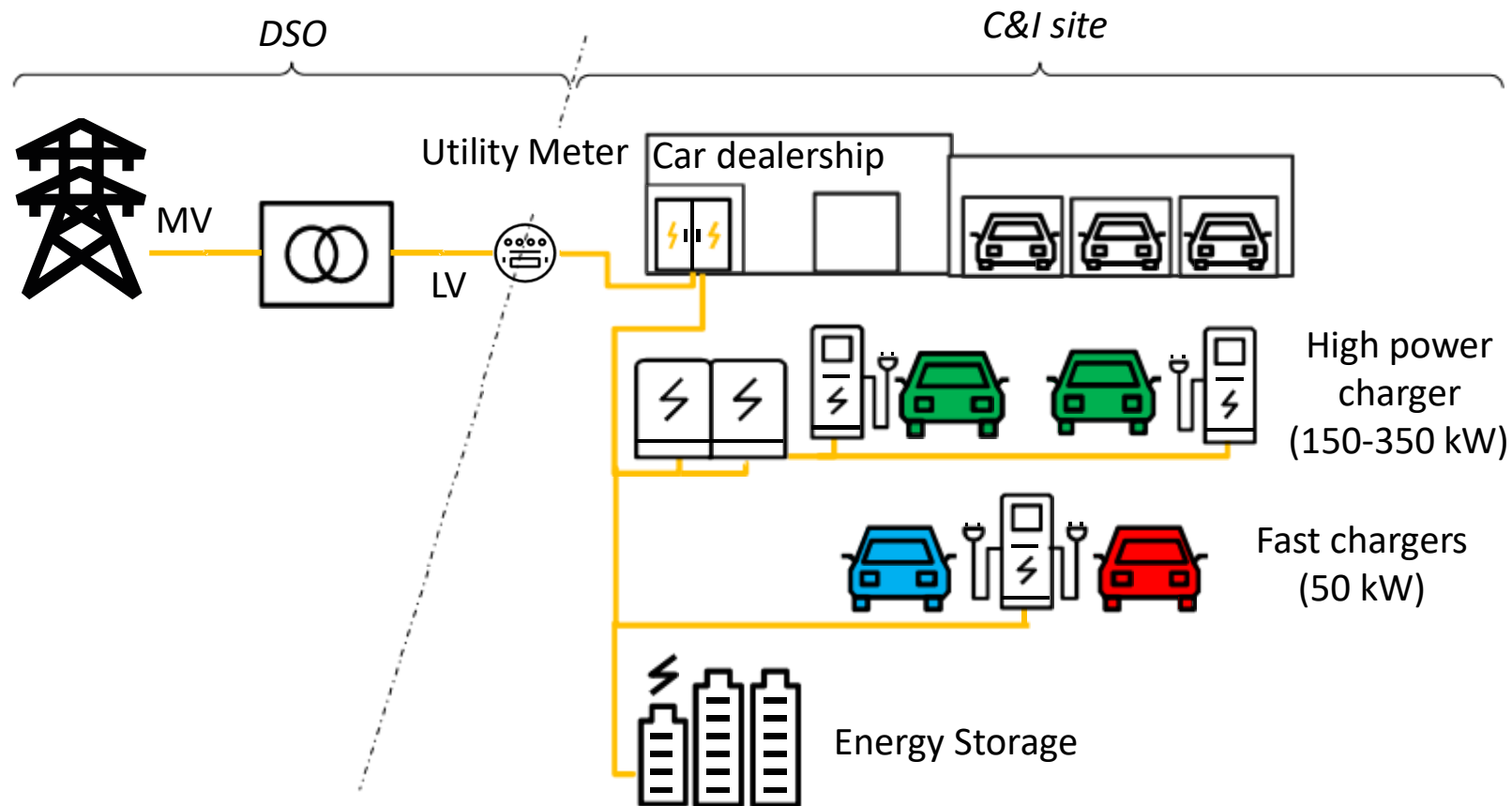
## Peak shaving

Peak shaving is similar to load leveling, but may be for the purpose of reducing peak demand rather than for economy of operation. The goal is to avoid the installation of capacity to supply the peaks of a highly variable load. Peak shaving installations are often owned by the electricity consumer, rather than by the utility.



# Integration of fast/high power chargers

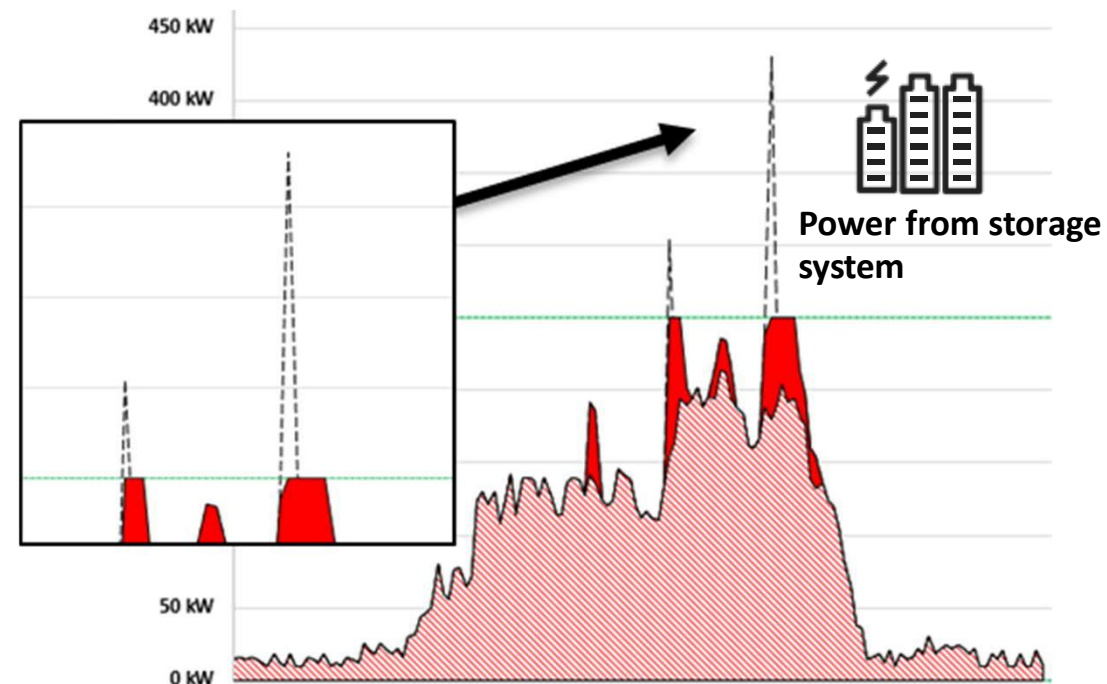
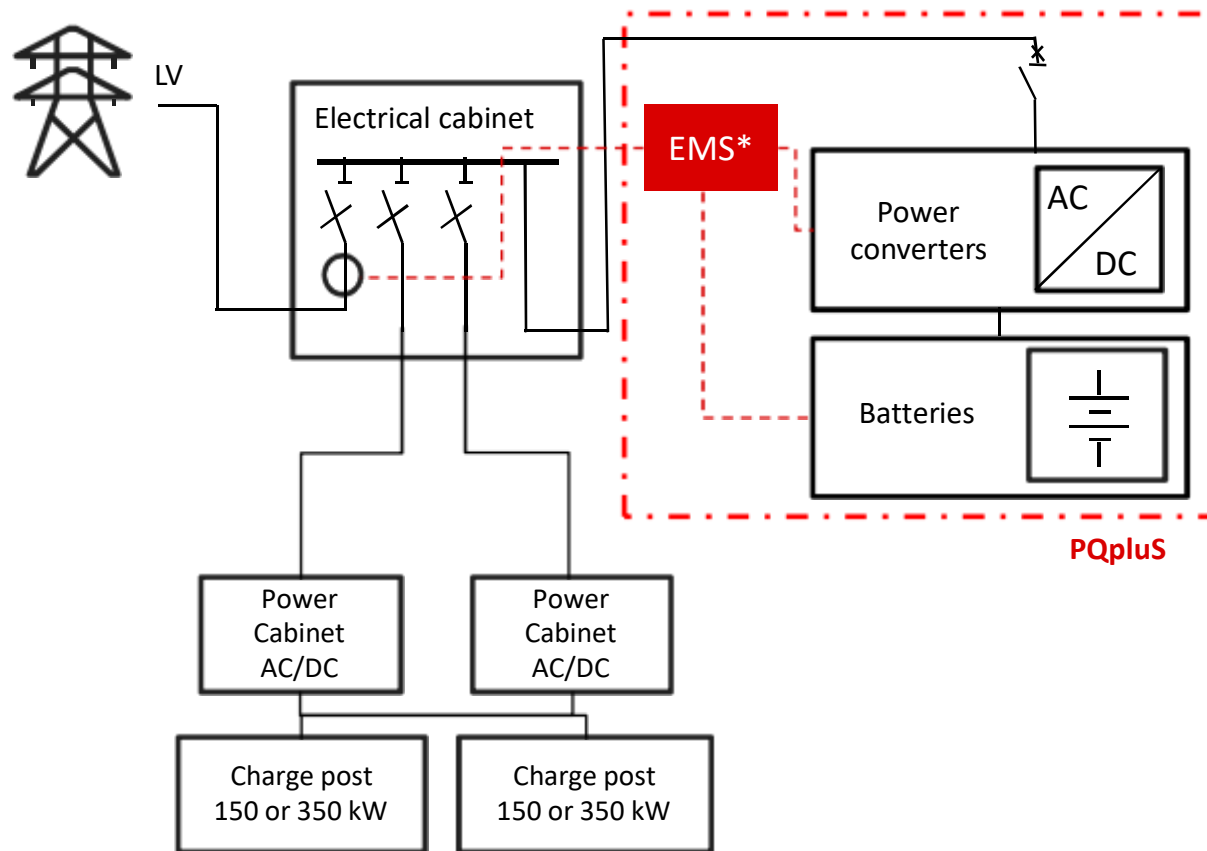
Example with a car dealership



Buffer energy storage enable integration of EV charging infrastructure to the existing grid connection without/with limited impact on PCC

# Integration of fast/high power chargers

## Architecture



# Main benefits of energy storage for EVCI integration

## Benefits of BESS for integration of EVCI



**Avoid grid connection upgrade and/or network reinforcement**



**Limited onsite electrification** (transformer, MV/LV substation) and associated impacts on civil work and footprint



**Limited contracted power** and associated OPEX savings

CAPEX & OPEX savings VS alternative electrification for integration of fast/high power chargers

## Additional value for the site



**Energy management** for existing C&I site, including peak shaving, maximization of self-consumption, energy supply optimization



**Power quality features** for the site (harmonic filtering, reactive power), back-up support



**TSO/DSO services** (Frequency regulation, voltage support,...)

Additional savings & new revenue streams to optimize the payback

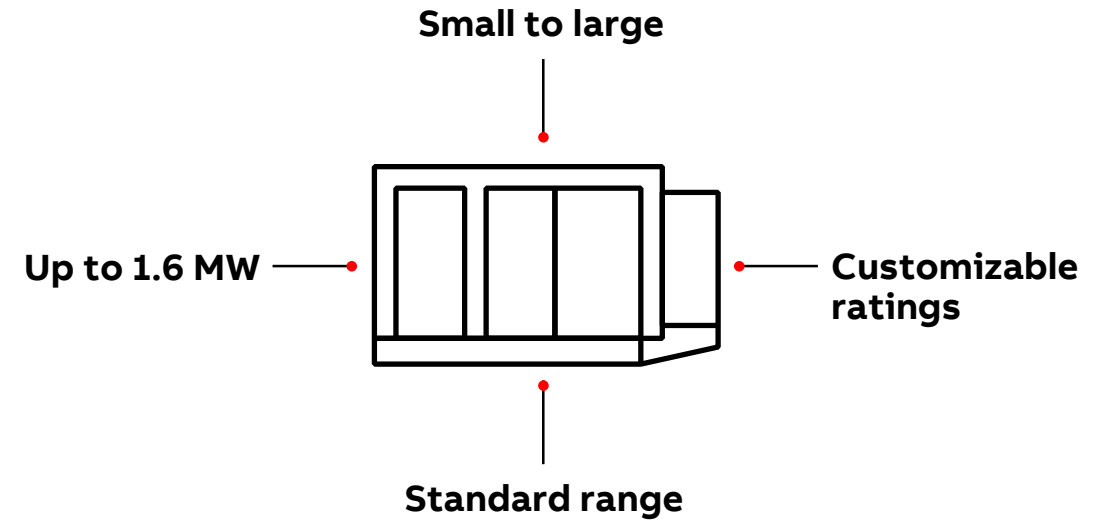


# BESS

## Range and features

### Complete range

- Small to large: covers a wide range of power (kW) and storage capacity (kWh)
- Smallest system starts at 30 kW/68.5 kWh
- Selection from standard range of modules
- Mix and match to get desired rating (kW/kWh)
- Modules for inverters, batteries or a combination of the two are available
- Power rating up to 1.6 MW



# PowerStore™

“Plug and play” solution, easily configurable to adapt your unique needs

## Climate Control

Maintaining temperature inside the container within an acceptable operating limit at all times

## Lithium Ion Batteries

Battery module, Racks, and Battery Management System (BMS) Interface

- Easy maintenance
- Online replaceable
- Hot-swappable

## PCS100

PowerStore™ Conversion System

- Scalable
- Modular
- Grid Forming
- Virtual Generator

## Health Safety and Environment (HSE)

Ensure health and safety appropriateness for all individual components and entire system of PowerStore™

## Remote Monitoring

Comprehensive solutions for unattended sites to increase productivity.

- Key Performance Indicators
- Real-time & historical data trends
- Configurable data sampling rate
- Support predictive, preventive and corrective maintenance

## Built-in PowerStore™ Automation

Dedicated Microgrid plus control system delivered pre-programmed to meet the application needs



# BESS

## Range and features

### Modular and compact

- Suitable for indoor as well as outdoor installation
- Outdoor version in a metal enclosure
- Selection from standard range of modules
- Easy to install - Plug & Play
- Different communication options
- Packed with features such as Peak Shaving, Back-up Power and Power Quality
- Bottom cable entry (for outdoor version)
- Different section of Inverters, batteries and control parts
- HVAC included in the outdoor version
- Firefighting system based on Condensed Aerosol Fire Extinguishing Agent such as StatX or similar (as an option)
- Separate LV compartment for housing the user interface, protection etc.



# PQplus

## Main Components - PQstorI

### Bi-directional inverters

- PQstorI range of inverters
- In-house production
- Wide power range (30 kW – 1600 kW)
- Loaded with Power Quality functionalities
- 3-Ph 3-Wire & 3-Ph 4-Wire capabilities



# PCS 100

## Power Module Types

PCS100 19- 03 C- A10 + A300

### Number of modules

01-06 for cabinets  
01-32 for racks

### Module type

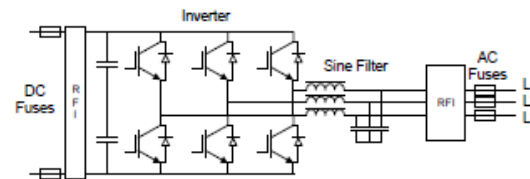
**C** – 1000 Vdc ( 750-1120 Vdc), 480Vac (150-480 Vac), 105 Aac, 50/60 Hz, ac transformer coupled (floating), dc side RFI is grounded.

**D** – 750 Vdc (250-820 Vdc), 480Vac (150-480 Vac), 150 Aac, 50/60 Hz, ac transformer coupled (floating), dc side RFI is grounded.

All PCS100 products use the same LV power modules which employ IGBT's and integrated sinusoidal filters. The ac and dc power connections of each module are protected by high speed semiconductor fuses. Multiple modules are connected in parallel to provide higher power.

The modules differ for the voltage range possible for the dc link. The modules are current rated and the available power output depends on the ac coupling voltage. The ac coupling voltage is further defined by the lowest possible dc link voltage. This is the minimum operational or discharging voltage of the storage.

An example of how to size PCS100 ESS converters is given later in this document. In addition an AC coupling transformer is needed to isolate the common mode voltage generated by the inverter switching. This ensures electromagnetic interference compatibility and allows the DC side to be ground referenced if desired.



# PCS 100

## Technical Specification

PCS100 19- 03 C- A10 + A300

### Mains connection

Voltage	Connect to any LV or MV with a standard transformer
Frequency	50 or 60 Hz

### Performance

Efficiency	> 97% at rated power (exc. transformer)
Voltage accuracy	+/- 1%
Frequency accuracy	+/- 0.1%
Power accuracy	+/- 3%
Overload capability	10 min 120 % 30 sec 150% 2 sec 200% (75 % preload for 200%)
MTTR	< 30 min by module exchange

### Environmental limits

Cabinet rating	IP21 or IP 23
Rack rating	IP20
Ambient temp.	0-50°C, de-rating for temps > 40°C (2%/K)
Pollution degree	2
Cooling	Forced air ventilation
Altitude	< 1000m. De-rate 1.2% per 100m above 1000m, maximum 3000m
Humidity	0-95% non-condensing
Noise	75-85 dBA @ 2m
Enclosure colour	RAL 7035 for cabinets

### Interface, programmable I/O's

Operator interface Colour touch screen

#### 2 analog inputs

Voltage signal	-10 to +10 V, R <sub>in</sub> > 200kΩ
Current signal	0 (4) to 20 mA, R <sub>in</sub> = 100Ω
Maximum delay	< 10 ms
Resolution	0.1 %
Accuracy	± 2%

#### 2 analog outputs

Voltage signal	-10 to +10 V
Current signal	0 (4) to 20 mA, load < 500 Ω
Maximum delay	< 50 ms
Accuracy	± 2 %

#### 9 digital inputs

Voltage signal	24 V DC, with internal or external supply, PNP & NPN
Input impedance	2.5 kΩ
Maximum delay	< 10 ms

#### 1 PTC input

#### 7 relay outputs

Rated voltage	250 V ac/1~, 30 V dc
Current	1 A

#### Serial communication

Modbus RTU	RS-485
Modbus TCP/IP	Ethernet via colour touch screen (read only)
Remote monitoring	Ethernet web server via colour touch screen

### Product compliance, Standards

IEEE 519  
ISO 9001 Quality assurance system  
IEC 62103 / EN 50178  
IEEE 1547 (pending)  
CE (pending)  
UL 1741 (pending)

# PQplus

## Main Components – Li-Ion batteries

### Storage batteries

- Li-Ion batteries
- Li-Ion is the preferred choice due to:
  - High energy density
  - Deeper depth of discharge
  - High charge-discharge cycles
- Front access for ease of installation and maintenance
- Voltage range
  - 635 Vdc – 820 Vdc





# Battery

## Usable energy: Analogy with a cinema



First people entering in the cinema can easily find a seat available areas last people entering in the cinema will need more time to find a seat.

If the flow of people entering is continuously low (= low Constant Power), most of people will find a seat. If all the people enter at the same time in the cinema (high Constant Power), it will be more difficult for the last to find a seat.

Solution would be to reduce the flow of people (= reduce the charging power) when the cinema is nearly full. This is what happen with your mobile or electric vehicle: charge fast up to 80% and then it takes more time to charge the remaining %)

If you need to maintain the same flow (= constant power), people will not find a seat before the movie start ...



# PQplus

## Energy Management System

### PQplus Controller (low level Energy Management System)

- ABB's programmable logic controller (PLC) or equivalent (Wago) as PQplus controller
- Functionalities offered such as peak shaving and back-up power
- System compatible with any other High level EMS (communicating in Modbus protocol)
- Can accept command (set points) from external (3rd party) high level controller for more complex applications such as frequency response, capacity firming, ramp rate control etc.



# PowerStore™ HMI

Dedicated visualization for PowerStore™

## Real-time view of your plant performance

With PowerStore™ HMI system you can remotely access, visualize, control and record most important variables/data from PV plant, wind turbines, feeders, and battery

- Simple intuitive user interface
- High-resolution trending, web based visualization packages, alarm system and event reporting
  - Local operation
  - Efficient maintenance
  - Remote access
- Optional Integration with plant level SCADA systems
- Interfacing with plant level control and visualization systems

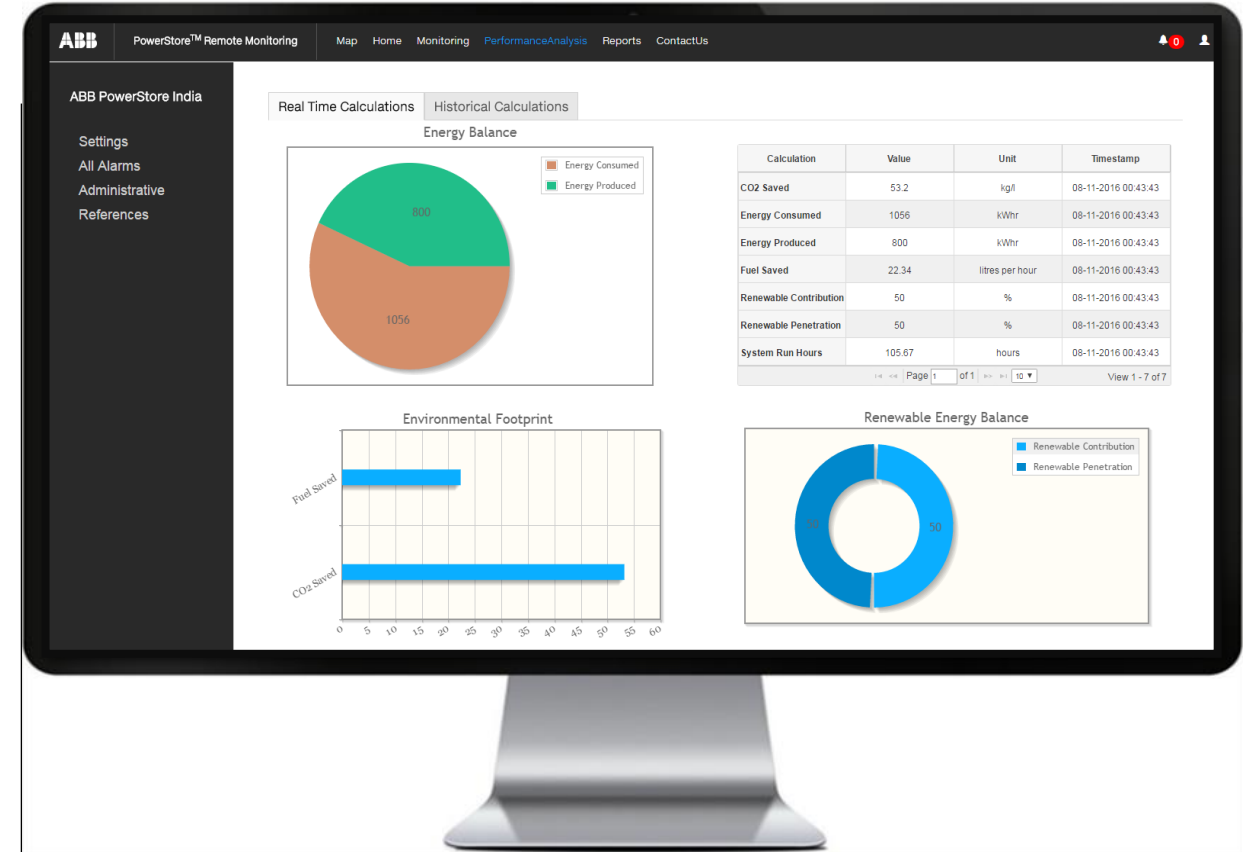


# PowerStore™ Remote Monitoring

## Efficient asset management

### Monitor your assets anywhere anytime

- A comprehensive solution for unmanned sites to increase productivity, improve energy efficiency and reduce operational costs
- Edge computing architecture
- Cyber security compliance
- Main features:
  - Real time monitoring
  - Real-time & historical data trends
  - Key performance indicators
  - Alarms and controller parameters monitoring
  - Reports generation
  - User account management and user profiles

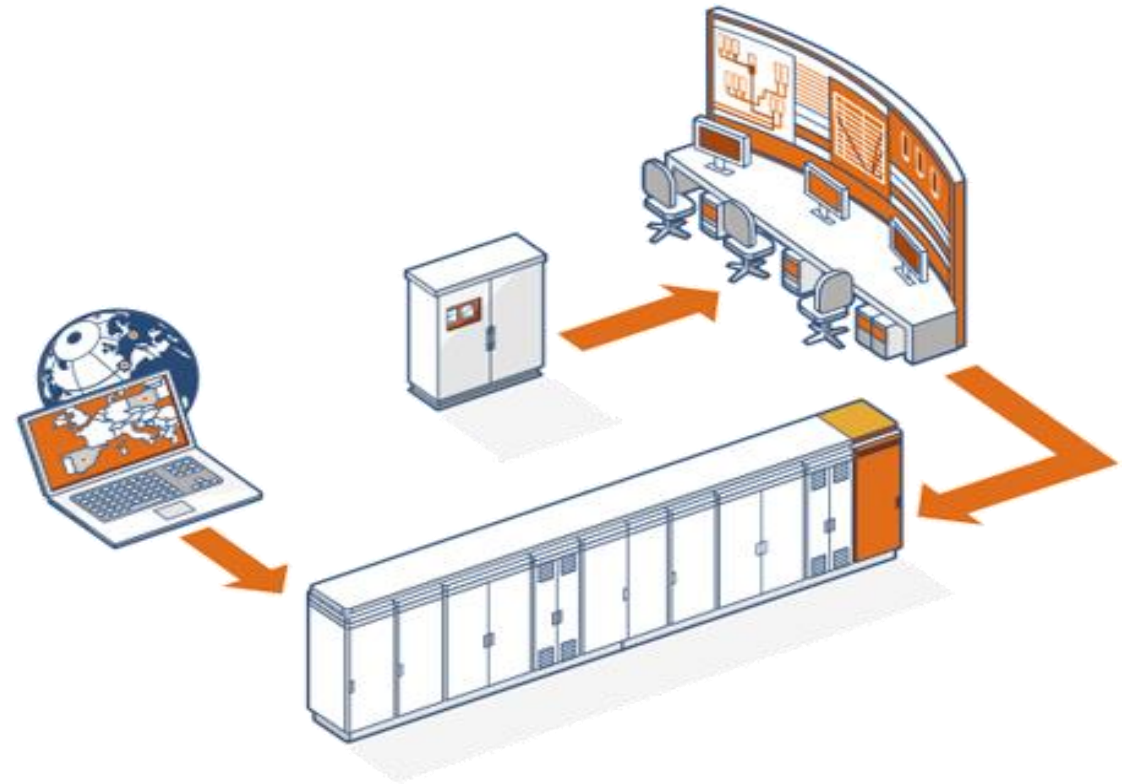


# PowerStore™ Remote Services

Improving operations and maintenance with remote optimization

## Cloud-based service portal

- A cloud-based remote service system that maintains the integrity of microgrid assets around the clock – anywhere in the world
- Helps customers to operate their microgrid at the highest possible levels of capacity, flexibility, reliability and operational security, and to extend the plant life cycle
- Detailed data analysis to optimize the operation and to protect the customer's return on investment
- Works 365 days a year, 24 hours a day
- Provide predictive, preventive and corrective maintenance
- Offer process analysis and support from skilled staff
- Remote diagnostics and remote operational control
- Multiple Microgrid managed by one platform
- Performance monitoring and reporting





# Technical specifications

# Battery energy storage systems

## Technical specifications

General	
Configuration	Modular
Location	Indoor or Outdoor
Max Ambient Temperature	50°C (104°F) <sup>1</sup>
Min Ambient Temperature	-10°C (23°F) non condensing
Max Average Temperature over 24h	35°C (95°F)
Altitude	<1000 m above sea level <sup>1</sup>
Relative Humidity	Maximum 90% RH non condensing
Interlocking (optional)	Mechanical or Solenoid (only for outdoor version)
Standards	IEC60529, IEC61439
	Optional Cyclonic Condition
	IEEE 693-2005 High seismic level

**Note**  
(1) Suitable derating applies beyond 40°C levels



# Battery energy storage systems

## Technical specifications

Electrical		
Grid Connection Voltage (+/- 10 %)		380VAC - 415VAC
Rated Output (+/- 10 %)		30 kW up to 1.6 MW
Frequency		50 or 60 Hz
Insulation Level		Up to 3 kV BIL
Arc Fault Mitigation (optional)		ABB REA101 Arc Fault relay, offered only for outdoor version



# Battery energy storage systems

## Technical specifications

Enclosure (Outdoor)	
Material	Mild steel, (Optional stainless steel grade 304)
Base frame	Hot dipped galvanized steel
Protection	IP55 (IP65 for battery section)
Door locking	Front: Lockable handle bolted type
Installation	Base fixing, on concrete footing or raised platform
Handling	Fork and crane lifting via base
Cable entry	Bottom only





# Battery energy storage systems

## Technical specifications

Enclosure (Indoor)	
Material	Mild steel
Protection	IP21 (IP30 for PQstorl, wall mounted version)
Installation	Free floor standing
Cable entry	Bottom

# Battery energy storage systems

## Technical specifications

Power Quality Characteristics	
Reactive power compensation: target cos $\Phi$	Programmable from 0.6 (inductive) to 0.6 (capacitive) <sup>1</sup>
Harmonic mitigation	
Harmonic range	from 2 <sup>nd</sup> up to 13 <sup>th</sup> harmonic
Harmonics selectable	3-wire/4-wire: 5 harmonics
Filtering target	Programmable for each harmonic in absolute Ampere value
Harmonic attenuation factor	Better than 97% at rated load
Response time	P: 20 ms <sup>2</sup> Q: 20 ms <sup>2</sup>
	Harmonics: 2 networks cycles typically (10-90% filtering)
Load balancing characteristics	Balance the currents between phases and/or between phases and neutral

**Note**

- (1) If cos  $\Phi$  of the installation is higher than the target cos  $\Phi$ , the filter will not downgrade the existing cos  $\Phi$ . The inverters can operate in 4-quadrant (100% real power to 100% reactive power).
- (2) Excluding communications delay

# Battery energy storage systems

## Technical specifications

Inverters			
Type	PQstorl - M	PQstorl - WM	PQstorl - C
	Module	Wall-mounted	Standalone cabinet
Rated power (at 400 V)	30 kW	80 kW	100 kW
Network frequency (+/- 5 %)			50 / 60 Hz
Equipment losses		<= 2 % of the equipment power typically	
Connection method			3-wire/ 4-wire
DC voltage (min)		590 V for 3 W application; 650 V for 4 W application	
DC voltage (max) <sup>1</sup>		830 V (890 V with reduced power)	
Overload capacity	150 % for 10 s once per 15 min (load history has a bearing on overload capacity)		
Redundancy		Master/master or master/slave arrangement	

### Note

(1) Other voltage range is possible for different AC input voltage. We reserve the right to choose the DC voltage range, depending on the rating and application of the storage system.



# Battery energy storage systems

## Technical specifications

Customer interface	
Interface point for communication	PLC based Energy Management System (EMS)
Communication protocol	Modbus TCP/IP, Modbus RTU (optional), OPC UA (optional)
HMI	Touch screen for setting parameter, consulting status, functions etc.
Connection for communication	Ethernet based (RJ45)
Additional communication interface with inverter	Wi-Fi, Touch screen (HMI)



# Battery energy storage systems

## Technical specifications

Batteries		
Type	Energy (1C)	Power (2C)
Model	Samsung 198S M2	Samsung 198S P3
Energy [kWh]	68.5 kWh	56.5 kWh
Capacity [Ah]	94 Ah	78 Ah
Nominal Voltage [v]	725 V	725 V
Voltage Range [v]	635 V - 821 V	614 V - 811 V
Weight [kg]	562 kg	562 kg



**ABB**