

EXTERNAL



EXTERNAL PRESENTATION

E-mobility Electrification Solutions

Electrification - Packaging and Solutions



Agenda

- Market size and growth
- Charging infrastructure basics
- ABB e-mobility infrastructure solutions by application
 - Bus depot
 - Bus en route charging
 - Industrial fleets
 - Commercial fleets
 - Roadside stations
 - Public commercial parking
 - Office/apartment charging
- Other considerations
- Digital options
- Value of ABB offering
- Detailed solutions by application



Market size and growth

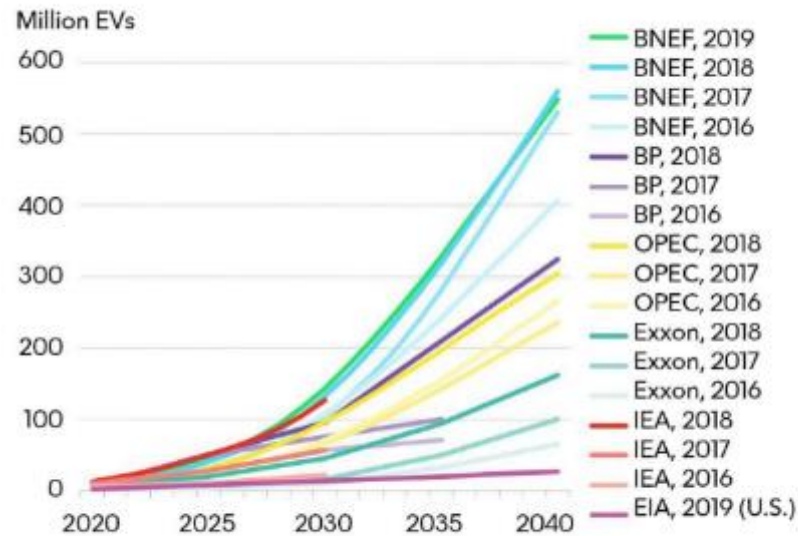
Trends in the industry

Growth of e-mobility market

The e-mobility market is growing at a record pace

Global EV outlook

EV Outlooks then and now



Source: BloombergNEF, organization websites. Note: BNEF's 2019 outlook includes passenger and commercial EVs. Some values for other outlooks are BNEF estimates based on organization charts, reports and/or data (estimates assume linear growth between known data points). Outlook assumptions and methodologies vary. See organization publications for more.

Drivers for consumers to buy electric vehicles

- Environmental - consumers desire to change to electric cars charged by clean, renewable energy
- Electric vehicles are approximately 3X-5X cheaper to charge/fuel
- Electric vehicles have 25% lower maintenance costs than internal combustion engine vehicles
- Electric vehicles can last 2.5X longer than internal combustion engine vehicles
- Initial cost of electric vehicles has decreased as battery costs have decreased

Drivers for retail, industrial, municipals and private companies

- Attract people to their stores, companies and cities
- To serve their customers, employees, and consumers
- Increase store sales as consumers spend time in their stores while their cars are charging
- Environmental stewardship
- New business models for petrochemical industry and store fronts
- To decrease traffic and parking within cities (buses, light rail)

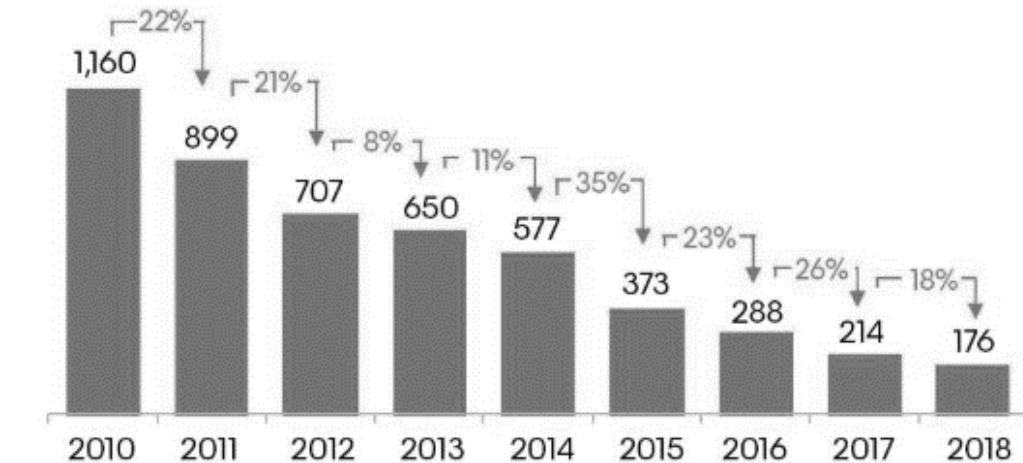
Industry trends driving growth

Lower battery pricing and tighter emission regulations continue to drive the trend towards EVs

Battery prices keep falling

Volume weighted average lithium-ion pack price

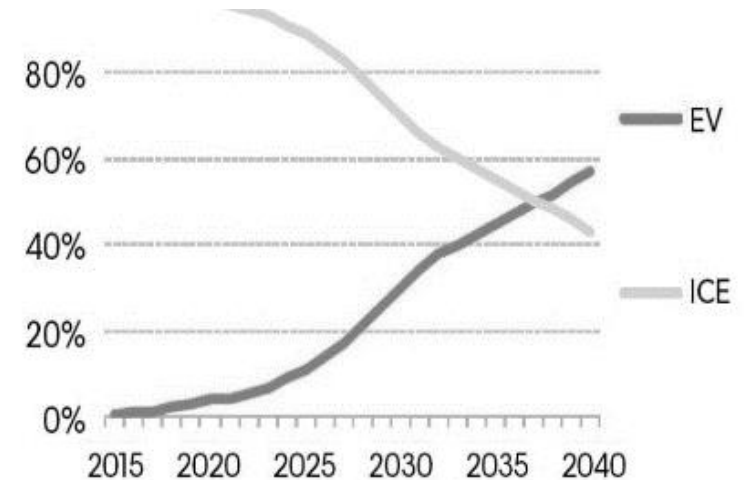
Real 2018 USD



Source: BloombergNEF

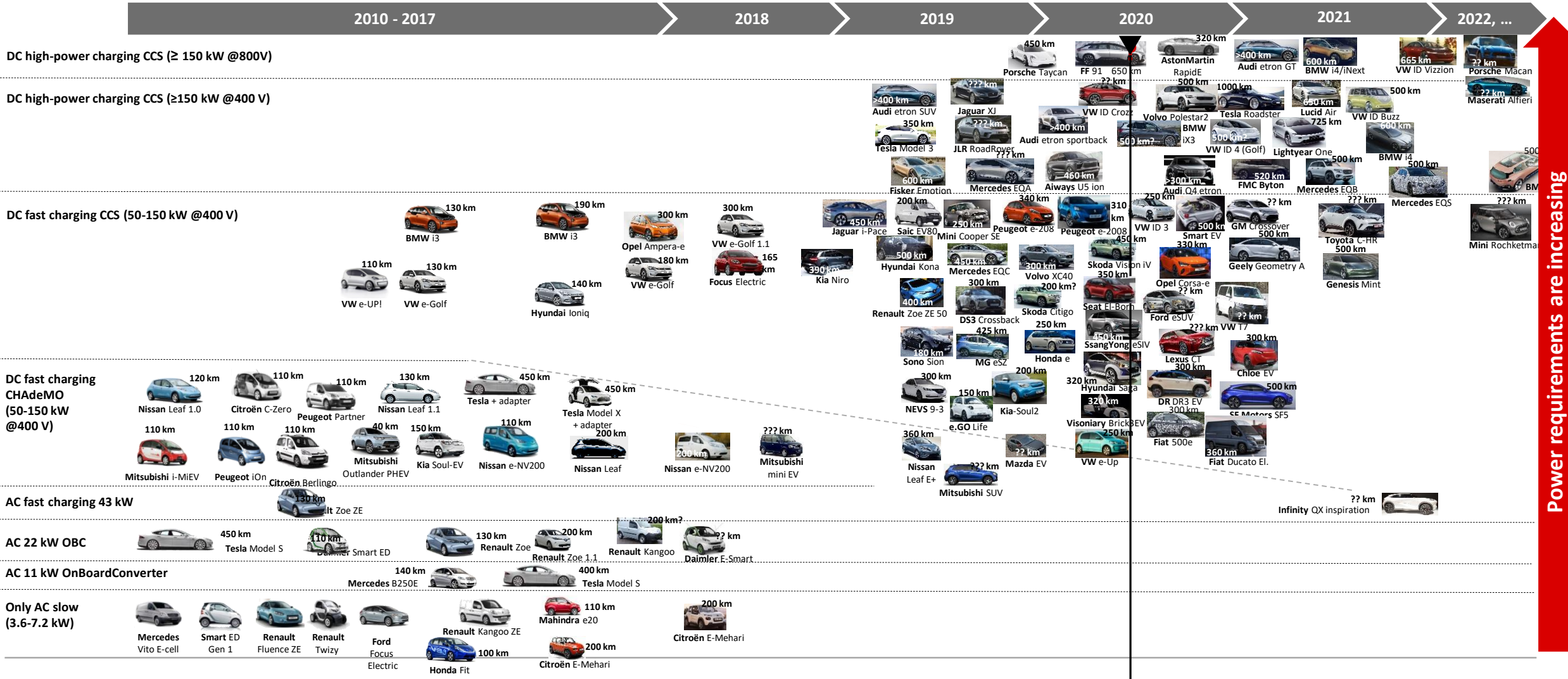
Emission regulations getting tighter and tighter

Global Electric Vehicle (EV) and Internal Combustion Engine (ICE) share of long-term passenger vehicle sales

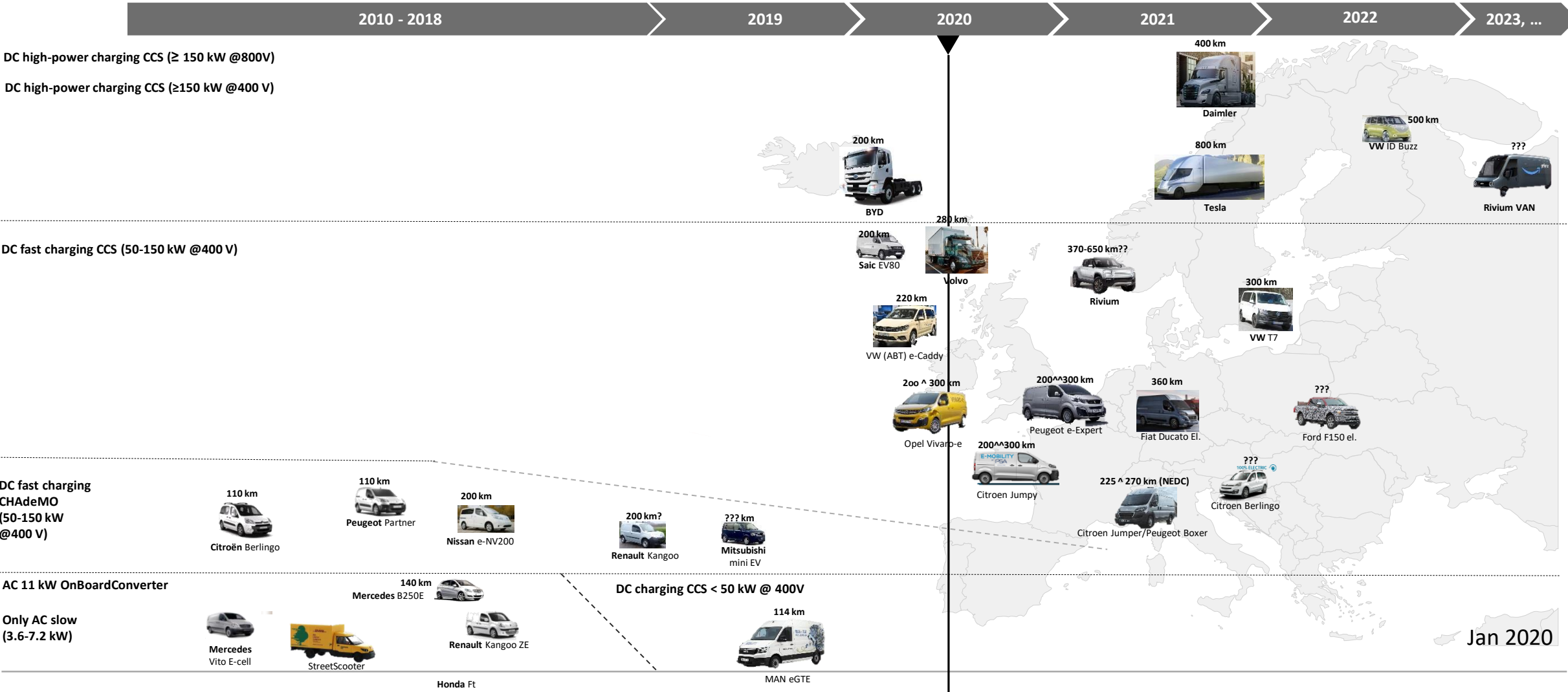


Source: BloombergNEF

Trend towards bigger cars with higher power requirements



Increasingly more electric commercial vehicles and truck models coming



Jan 2020

Trends toward faster charging times and higher power

As electric vehicles increase in use, quicker and higher power charging infrastructure is needed

Bus Depot



Medium Voltage
Typically 3- 8 hrs overnight

eBus En-route Charging



Medium Voltage
Typically 3-6 mins

Industrial Fleet



Medium Voltage
Varies significantly by application

Commercial Fleet



Medium Voltage
Typically 3-8 hrs overnight

Road-Side Fast-charging Station



Medium Voltage
Typically 10-20 min

Public Commercial Parking



Medium Voltage
Typically 20-90 min

Office / Apartment Charging



Low Voltage
Typically 8 hours

Residential Charging

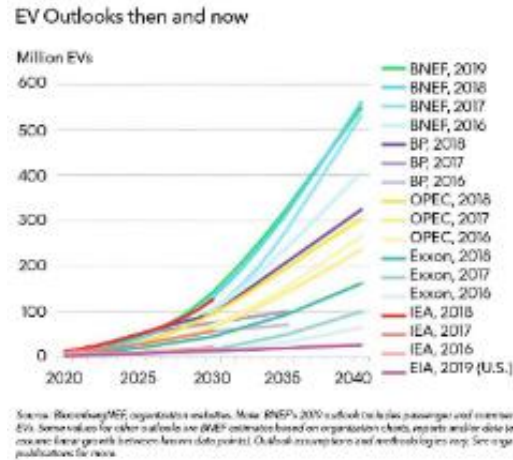


Low Voltage
Typically 8 hours overnight

Trends in electrical infrastructure

Movement towards higher power chargers and faster charging times = MV grid connection

Ever-increasing # of electric vehicles +



Bigger cars, higher power needs, longer ranges +

2007

Only AC slow
(3.6-7.2 kW)



Honda Fit
100 km

2019

DC high power
charging CCS
(≥150 kW @400 V)



Audi e-tron SUV
>400 km

Faster charging times



Overnight charging
8+ hours



High power charging
10-20 mins

Different electrical infrastructure is needed to support the load:

- Leading to more MV grid connection installations
- Energy storage to allow fast charging in LV grid connection
- High safety requirements for equipment in public installations
- Relocatable energy storage allows site locations to be evaluated without premature permanent infrastructure costs

The future of mobility is electric

Now is the time to future-proof your electrical infrastructure

The key to future-proofing is investing in the right combination of traditional and smart solutions, ensuring the infrastructure can be scaled in close alignment with growing demand

- E-mobility is coming, and its **tipping point will arrive much sooner** than most people expect
- Experts predict that just a couple of decades from now, **there will be more than 540 million electric vehicles crowding our roads** – and their energy needs will be much more intense than today's first generation of electric vehicles.
- To make your investment count and to earn the full ROI on the electrification of transport, the technology you install has to be both **scalable and futureproof**
- New long-range EVs demand fast-charging at higher power levels. Make sure that your e-mobility solution is **ready to grow both in size and sophistication**.
- Smart, connected technologies, such as energy management or battery energy storage, provide a means of **utilizing current electrical infrastructure** and avoiding or delaying costly grid expansions in markets where e-mobility is still in early stages.
- Fleet operators and transportation authorities are facing challenges, such as technological uncertainty, large up-front investment, and need for new capabilities. ABB's holistic approach provides a **complete e-mobility solution** helping fleet operators effectively outsource many of these uncertainties.










Charging infrastructure basics

Types of charging infrastructure and application

E-mobility solutions landscape for cars and fleets

Applications, charging times and power options

Public and commercial EV Charging				
AC destination	DC destination	DC Fast	Depot Charging	DC High Power
3-22 kW	20-25 kW	50-180 kW	50-150 kW+	150-350 kW+
4-16 hours	1-3 hours	20-90 min	4-8 hours	10-20 mins
				
<ul style="list-style-type: none">– Office, workplace– Home– Multi-family housing– Hotel and hospitality– Overnight fleet– Supplement at DC charging sites for PHEVs	<ul style="list-style-type: none">– Office, workplace– Hotel and hospitality– Parking structures– Dealerships– Urban fleets– Public or private campus– Sensitive grid applications	<ul style="list-style-type: none">– Retail, grocery, mall, big box, restaurant– High turnover parking– Convenience fueling stations– Highway truck stops and travel plazas– OEM R&D	<ul style="list-style-type: none">– Fleet depots for bus, truck and light commercial vehicle (LCV), and industrial vehicles charging– Private campus– Central bus depots and bus-line turning point– Bus, truck and LCV, and industrial vehicles	<ul style="list-style-type: none">– Highway corridor travel– Metro “charge and go”– Highway rest stops– Truck stops– Petrol station areas– City ring service stations– OEM R&D

ABB's portfolio of EV chargers span across multiple charging applications

EV charging experts can help identify the right solution for your charging operation







Public and commercial EV Charging				
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----- Alternate use-cases for depots

E-mobility solutions landscape for cars and fleets

Applications, charging times and power options

Our focus for this presentation






Public and commercial EV Charging				
AC destination	DC destination	DC Fast	Depot Charging	DC High Power
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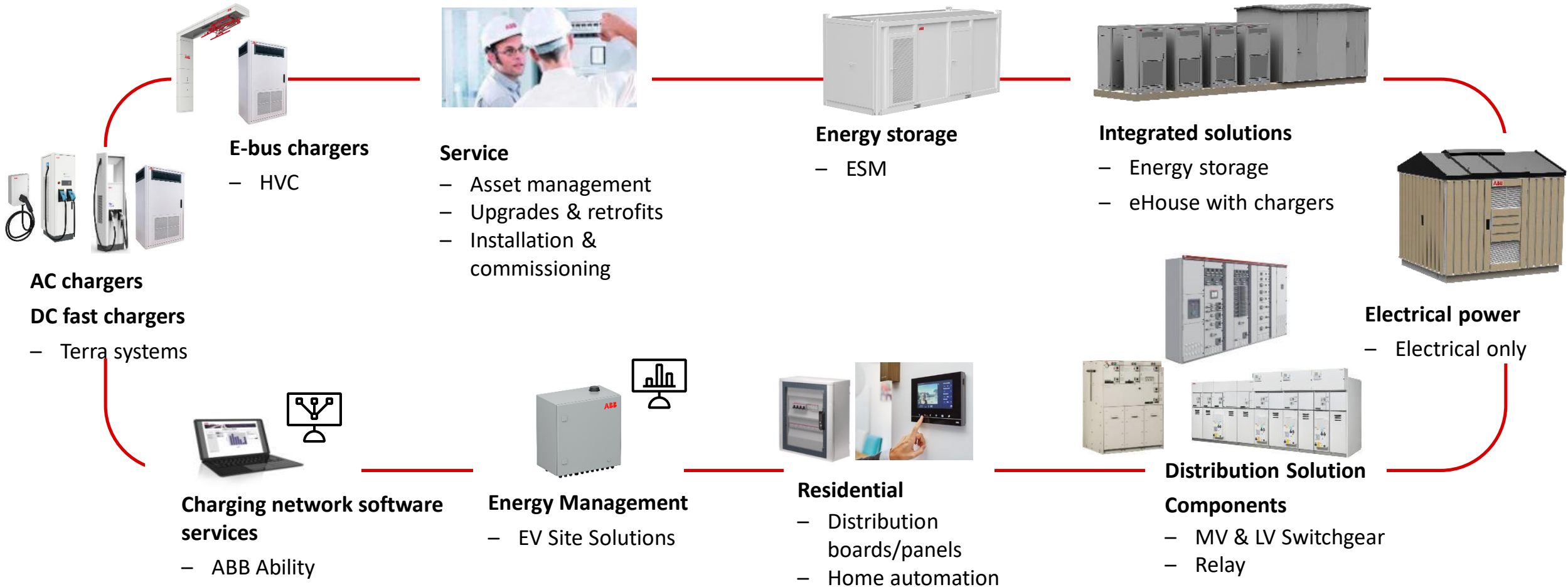


ABB e-mobility electrification infrastructure solutions

Overview

ABB Electrification has the complete line of charging infrastructure solutions

Your one-stop shop for e-mobility infrastructure



Electrical systems supporting chargers get more complex

As power levels rise charging locations may need to bolster their electrical infrastructure as well

Public and commercial EV Charging				
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ABB Charger <ul style="list-style-type: none">– AC charger Electrical Infrastructure <ul style="list-style-type: none">– Circuit protection– Residual current protections– Smart meters - optional for facility energy management	ABB Charger <ul style="list-style-type: none">– DC charger Electrical Infrastructure <ul style="list-style-type: none">– Cable pillars– Circuit protection– Residual current protections– Energy management solutions	ABB Charger <ul style="list-style-type: none">– AC or DC charger Electrical Infrastructure <ul style="list-style-type: none">– Switchboards– Cable pillars– Energy management solutions	ABB Charger <ul style="list-style-type: none">– AC and DC charger(s) Electrical Infrastructure <ul style="list-style-type: none">– LV Switchgear– MV Switchgear– Switchboards– Distribution transformers– Enclosures or skids– Battery Energy Storage System– Energy management solutions	ABB Charger <ul style="list-style-type: none">– DC charger(s) Electrical Infrastructure <ul style="list-style-type: none">– LV Switchgear– MV Switchgear– Switchboards– Distribution transformers– Enclosures or skids– Battery Energy Storage System– Energy management solutions

Electrification offering

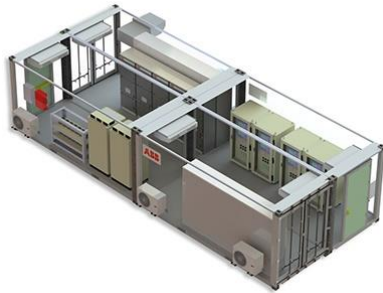
Customized Solutions

Description

Customized solution for a specific project. Offering for complex, non-standard, jobs requiring multiple ABB products and services.

Offerings

- Custom designed product packages
- Customized eHouses, skids and mobile substations



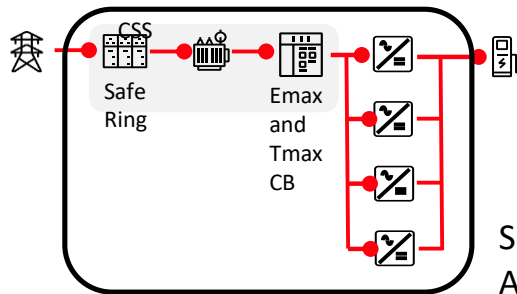
Solution Architectures

Description

A pre-engineered solution development with digital applications. Packages ABB products into a turnkey digital solution for specific applications.

Offerings

- Offerings by segment and specific application
- Digital offering with key benefits for user application



Solution Architecture

Productized solutions

Description

Productized solution that is pre-engineered, pre-fabricated, and type tested for rapid deployment.

Offerings

- Standardized eHouses and skids; ex. EcoFlex
- Compact Secondary Substations (CSS)
- Energy Storage Modules (ESM)



Productized Solution

Electrification offering – Productized solutions

Building blocks for e-mobility

Electrical infrastructure

- Built as modular or expandable solutions for future-proofing
- Aesthetically pleasing enclosures to help hide necessary infrastructure in plain sight



Integrated charger solution

- Ideal for turnkey charging solutions that can be commissioned quickly on-site
- Bridges the gap of connecting charging and electrical infrastructure
- Provides flexible solutions from reliable vendor with common products



Battery energy storage

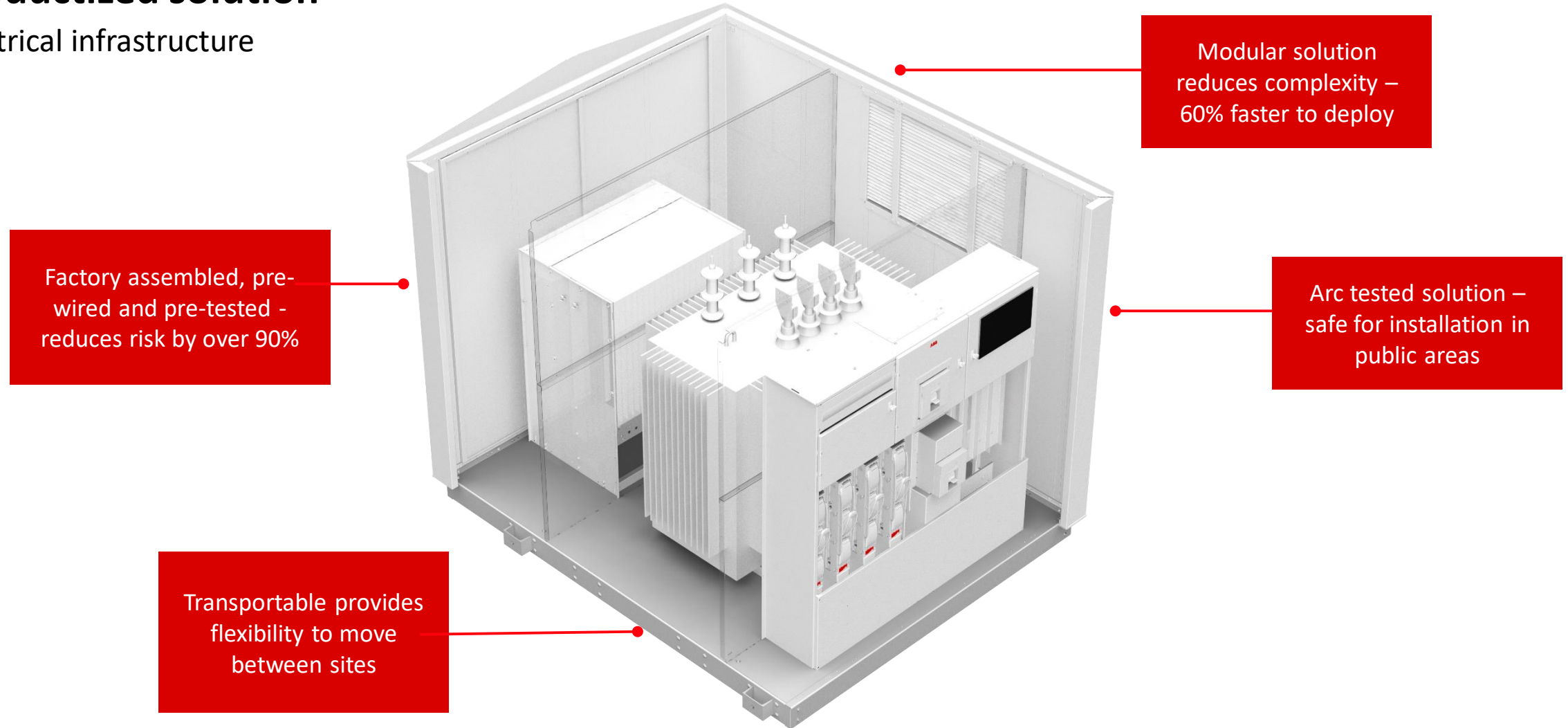
- Available with synchronized charging and is especially important where grid constraints limit charging power
- Ideal for peak shaving especially for fleets where multiple cars charge
- Ideal way to connect solar to local chargers reliably



Integrated load management across all building blocks provides fast deployment and reliable operation

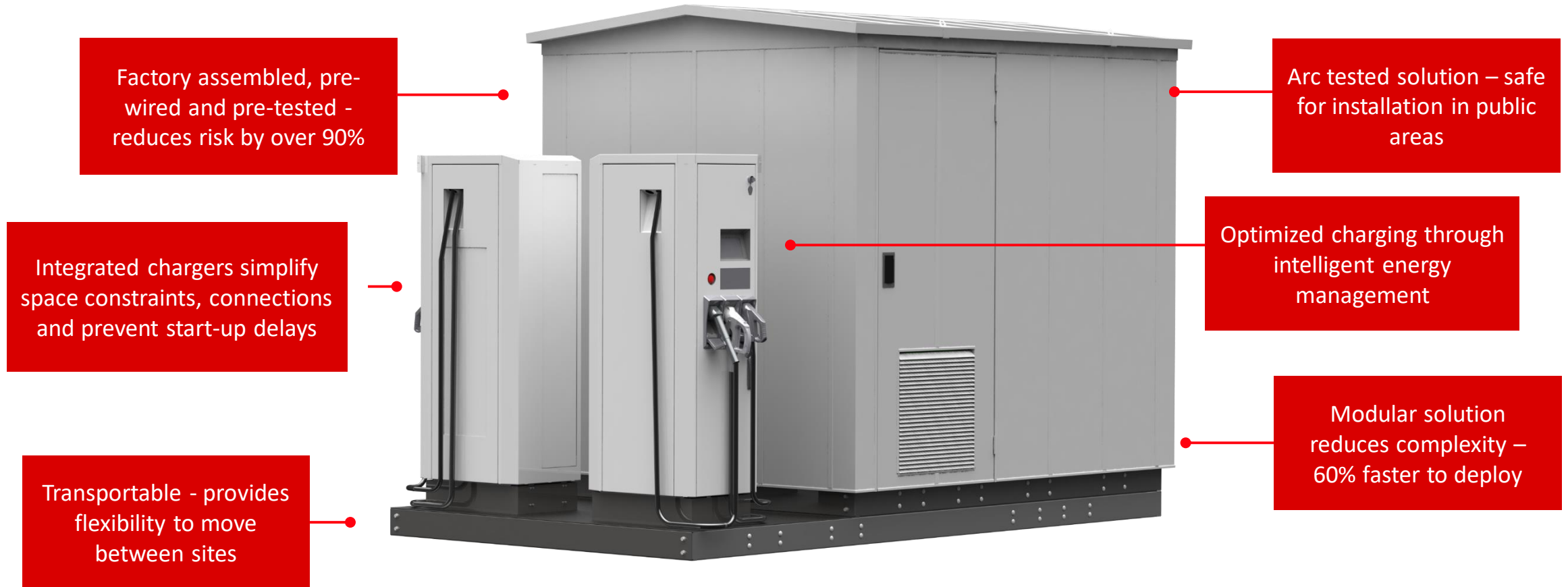
Productized solution

Electrical infrastructure



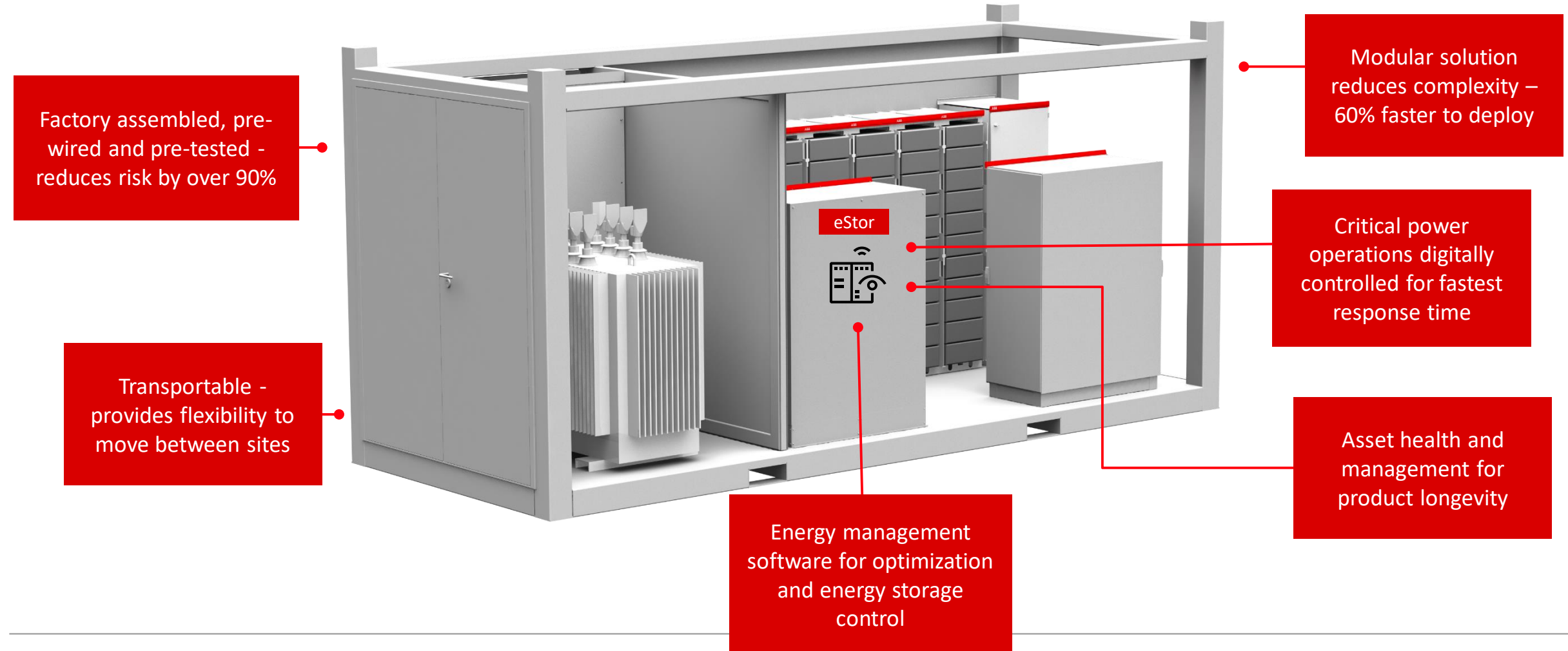
Productized solution

Integrated charger solution



Productized solution

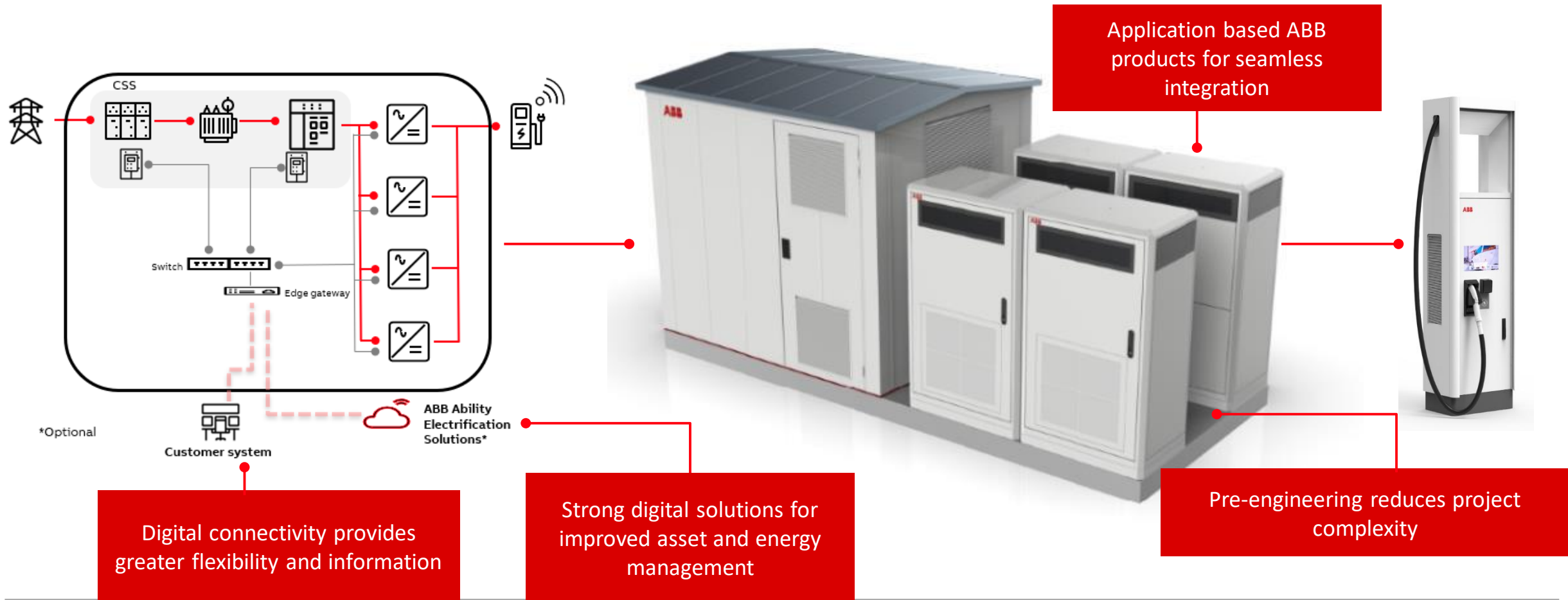
Energy storage



Solution architecture

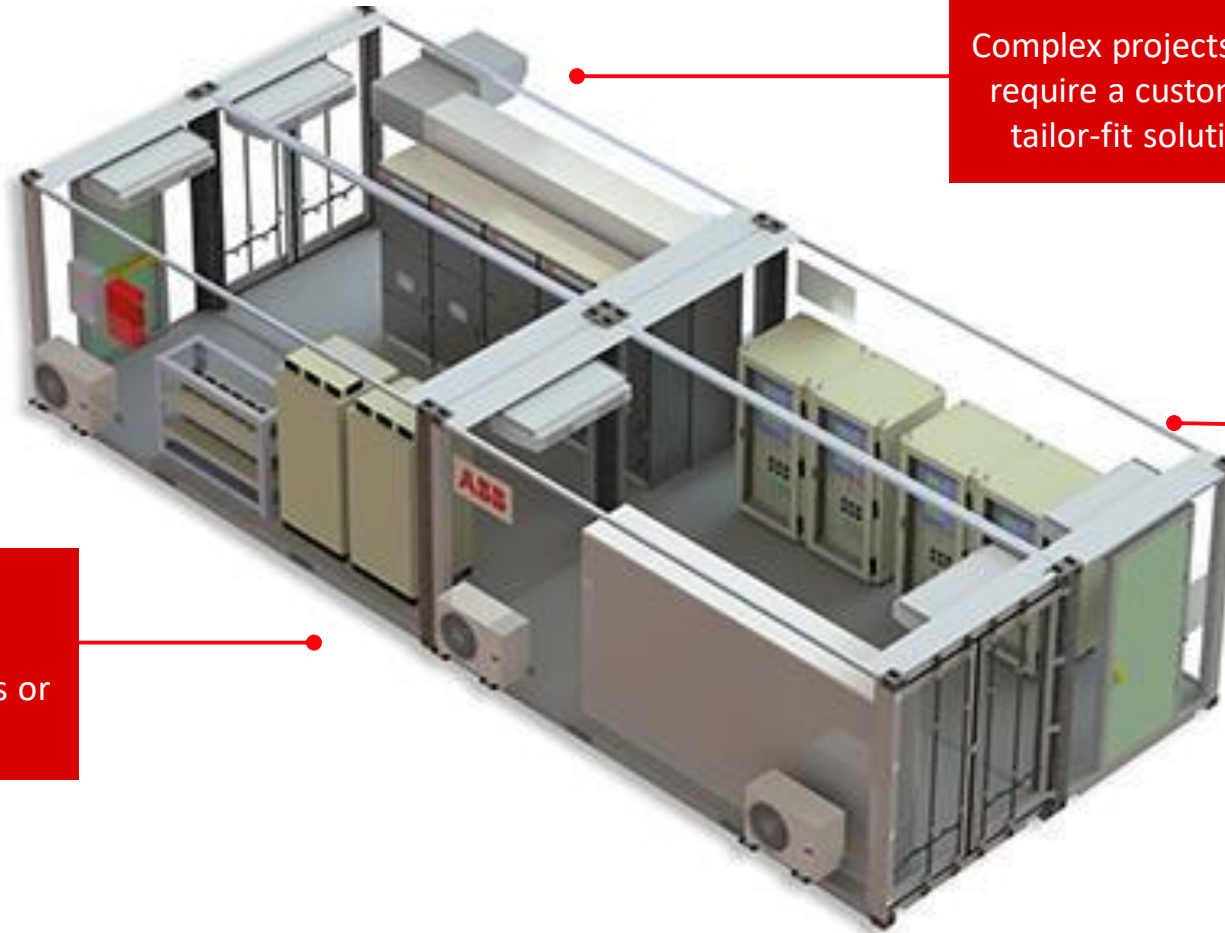
Electrification and digital offering

Combines **products**, **pre-engineering** and **digital applications** to create scalable solutions to fit specific application requirements



Customized Solutions

Packaging & eHouses



Custom engineering –
unique product
engineering requirements
to specific specifications

Complex projects that
require a custom or
tailor-fit solution

Project that requires
design, engineering,
integrated components,
manufacturing and
project management

Enclosures can vary
depending on job
demands; eHouse, skids or
mobile substations

ABB's e-mobility integrated solutions

Benefits of integrated electrical and charging infrastructure

- Modular and scalable, plug-and-play solutions **reduce complexity and are 60% faster to deploy**, helping customers turn ideas about sustainability into quick action.
- Factory assembled, pre-wired and pre-tested solutions assure a smooth startup
reducing risk by over 90% that modifications will be required on site
- Internally arc tested unit offers the **highest safety for people and equipment**, with solutions tested according to IEC requirements for public installations
- The ability to place this solution in public spaces can **save 30% on installation costs** — no fencing or security required.
- Relocatable solution provides means **proposed site locations are evaluated temporarily without disruptive and costly grid connection expansions**. The permits required for temporary solutions are also often easier and faster to obtain.



- Transportable solution provides **flexibility** to move between sites with **simplified logistics**.
- Energy storage can easily be added in the future to cover higher peak demand and/or
resolve grid limitation issues.
- Easy to transport and handle or relocate; many designs are stackable,
reducing land space requirements; some designs fit into standard parking space.
- Digital connectivity, intelligent energy management, predictive maintenance, and deep insights and statistics at the charger, the site, and the network level **optimize e-mobility charging operations**.

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Offering by application

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Bus depot

Bus depot



Overnight charging

- After operation most buses will go back to the depot, an ideal time to charge the bus overnight.
- Average parking time is between 6-8 hours
- Depending on the battery capacity and the targeted charging times, charging power is between 25kW to 150kW
- Before start of route, most buses will require pre-conditioning to either heat up or cool down the interior
- Charging can be done 1:1 (1 charger per bus) or 1:3 (1 charger per 3 buses) combined with sequential charging.
- Supported connection to bus
 - Connectors
 - Pantograph Up
 - Pantograph Down



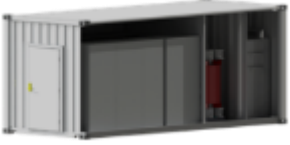


Bus depot

Integrated solution

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with HP chargers	Up to 1kV		IEC, ANSI	LV protection equipment, energy management system, high power charging posts	Expandable uses with ES and HP chargers, quick start from LV connection, movable
	UniSub with HP chargers	Low voltage connection		IEC, ANSI	LV switchboard, HP chargers	For plug-and-play charging requirements with only LV connection, visually appealing




Bus depot

Battery energy storage building blocks

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with energy storage	2.4 – 40.5kV Typical rating (kVA): up to 2000 kVA	Up to 1800kW/1800kWh	IEC, ANSI	MV switchgear, transformers, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	CSS with energy storage	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA	Up to 1000kW/1000kWh	IEC, ANSI	MV switchgear, transformers, LV circuit breakers, energy storage	Ideal for scalable solutions with power demand buffering and energy backup
	EcoFlex Energy Storage Modules	Up to 1kV	Up to 500kW/500kWh	IEC, ANSI	LV switchboard, energy storage	Plug-and-play low voltage energy storage solution, easy to ship and set up

Bus depot

Electrical infrastructure building blocks

		Voltage rating	Applicable standards	Standard components	Key solution features
	Multi-module EcoFlex	Up to 40.5 kV	IEC, ANSI	MV switchgear, transformers, UPS, LV connections, battery rack, charger, RTU	Modular solution, scalable design for futureproofing, fast installation
	EcoFlex	2.4 – 40.5kV Typical rating (kVA): up to 4000 kVA	IEC, ANSI	MV switchgear, transformers, LV circuit breakers	Designed for transport, remote locations, fast installation, expandable uses including energy storage
	Compact Secondary Substation (CSS)	2.4 – 40.5kV Typical rating (kVA): up to 3150 kVA	IEC, ANSI	MV switchgear, transformer, LV switchboard	Versatile configurations and functions with quick setup and pre-engineering

Complete e-mobility solution for high power large bus depot

With vertically integrated and connected solution from grid to charging point

ABB delivered complete depot electrification and charging solution









Digitalization

Low and medium voltage
power

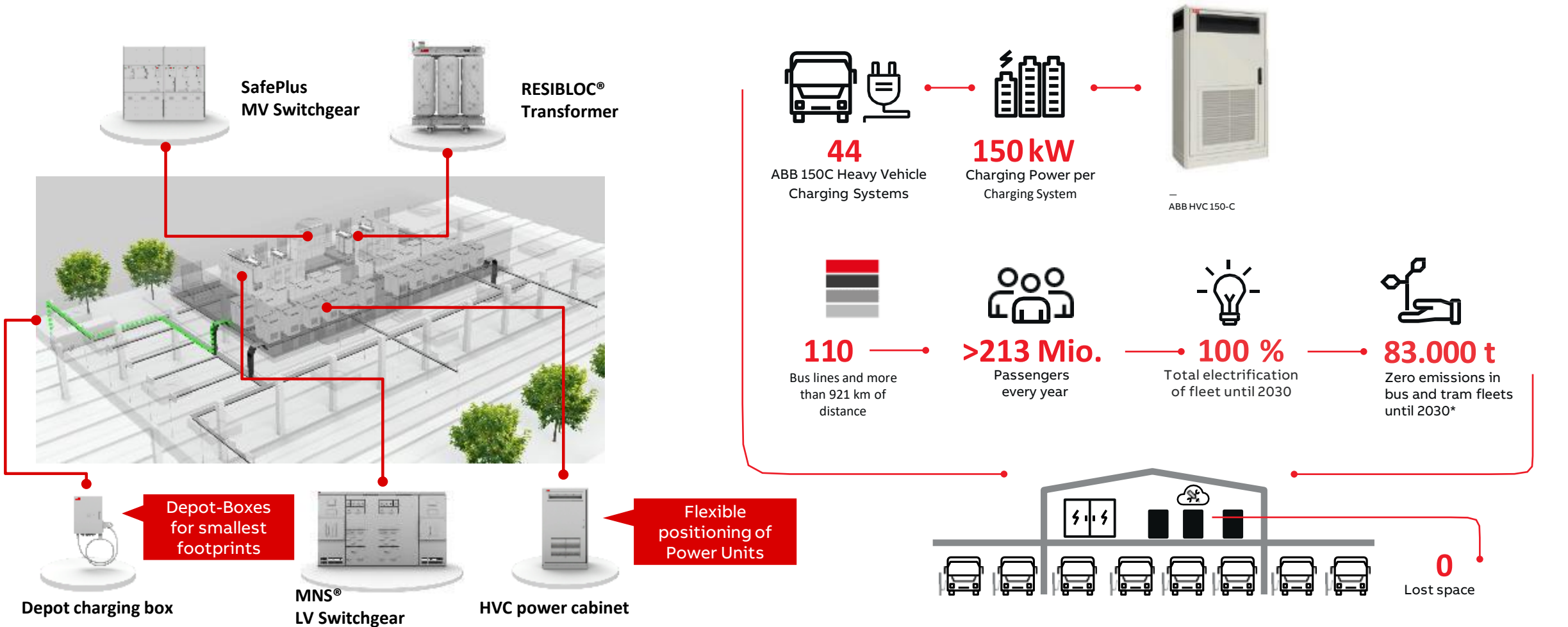
High power chargers

Value proposition and customer benefits

-  **Complete solution** from grid connection to charging point, including a pre-fabricated building
-  **Increased uptime** thanks to digital service support
-  **213 million passengers** transported each year
-  **110 bus lines** electrified, covering more than 920 km
-  **100% fleet electrification**
-  **Emissions-free operations**

Reference case: Hamburg Hochbahn

The first fully electric bus depot in Germany



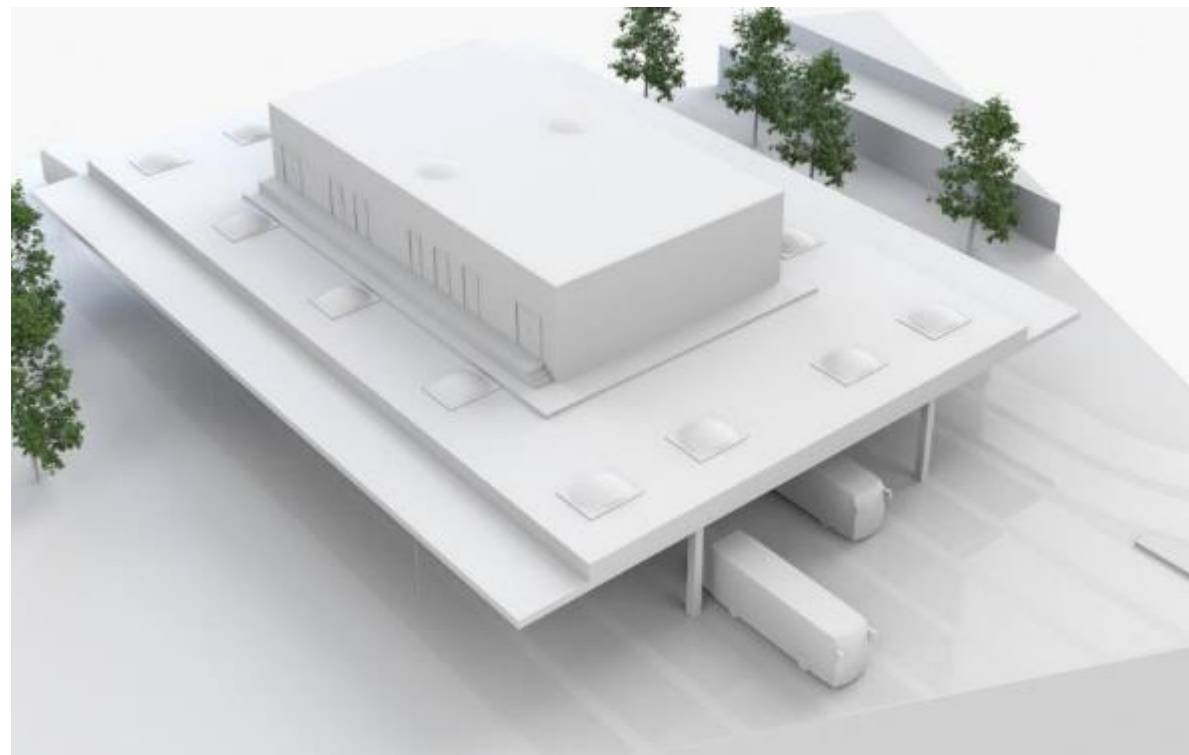
E-mobility solutions for high power depot applications

Simulation of reference case implementation

Side view



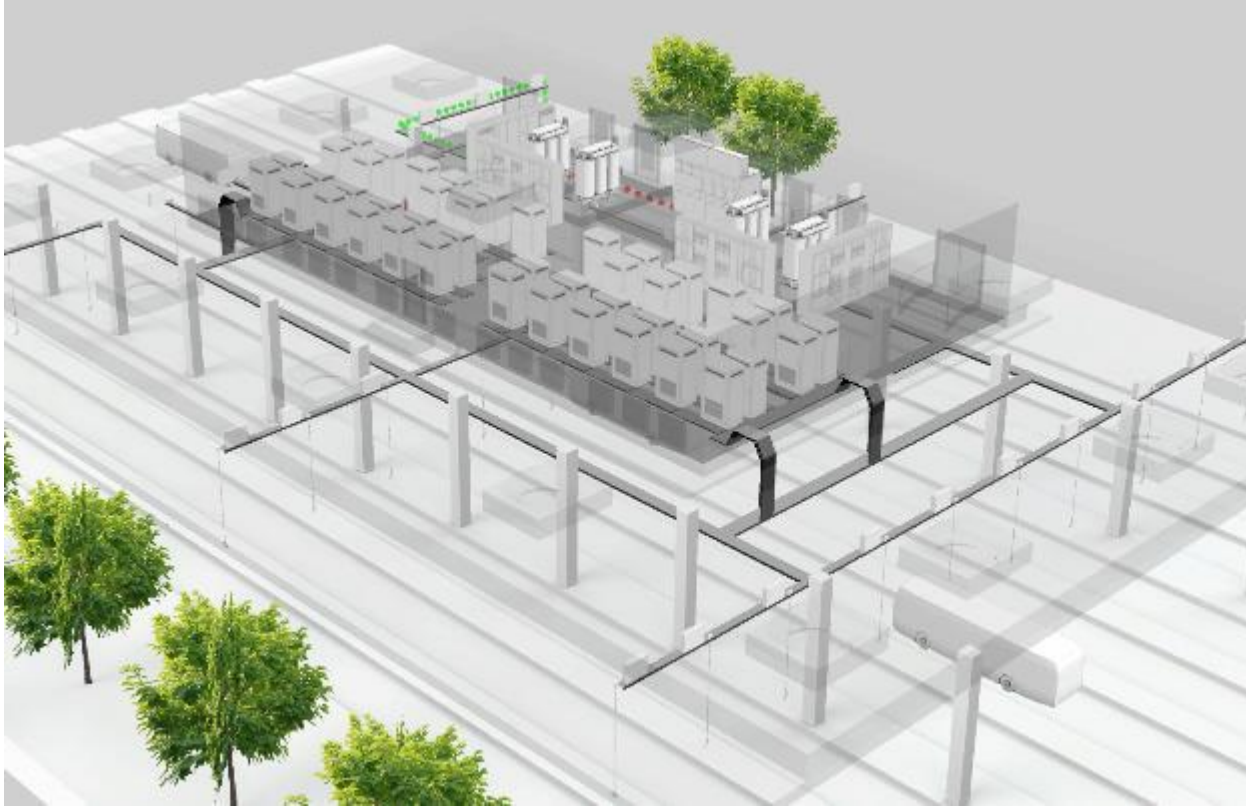
Top view



Bus depot

Rooftop solution

Topview/x-ray mode



- Complete electrical infrastructure included in one e-room
- E-room comprising of MV-Switchgear, Dry type transformers, LV-Switchgear, 44 units of 150kW power cabinets, RTU based communication system, UPS, Aircon , depot boxes beneath floor level
- ABB providing a “one-package” solution, with coordination of interfaces between products and partner-scope
- “One package” solution gives the highest degree of control for timeline and interoperability
- Pre-assembled configurations (Skid/eHouse) can further support quick and hassle-free installation / commissioning at site

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eBus en route charging






eBus en route charging

- Charging during daily operation at any given stop or rest opportunity.
- This offers an ideal solution to ensure zero-emission public transit during the day without impacting on the normal operation of the route.
- Charge time typically is between 3 and 6 minutes and requires an automated connection device and high power charging.
- Charging power is between 150kW to 600kW.
- Supported connection to bus
 - Pantograph down
 - Pantograph up








eBus en route charging

Integrated solution

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with HP chargers	Up to 1kV		IEC, ANSI	LV protection equipment, energy management system, high power charging posts	Expandable uses with ES and HP chargers, quick start from LV connection, movable
	CSS with HP chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV switchboard, HP chargers	Quick setup solution for plug-and-play charging requirements
	UniSub with HP chargers	Up to 1kV		IEC, ANSI	LV switchboard, HP chargers	For plug-and-play charging requirements with only LV connection, visually appealing
	EcoFlex w/ energy storage & HP chargers	2.4 – 40.5kV	Up to 400kW/400kWh	IEC, ANSI	MV switchgear, transformer, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	Bus charging station	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC	MV switchgear, LV circuit breakers, transformers	Single piece delivery, connects to local monitoring



eBus en route charging

Battery energy storage building blocks

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	EcoFlex with energy storage & HP chargers	2.4 – 40.5kV	Up to 400kW/400kWh	IEC, ANSI	MV switchgear, transformer, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	EcoFlex Energy Storage Module	Up to 1kV	Up to 500kW/500kWh	IEC, ANSI	LV switchboard, energy storage	Plug-and-play low voltage energy storage solution, easy to ship and set up
	Charging station with energy storage	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA	200kWh/200kW – 300kWh/500kW	IEC	MV switchgear, LV circuit breakers, transformers, energy storage	Ideal for weak grid supply, energy storage, fast installation

eBus en route charging

Electrical infrastructure building blocks

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	Compact Secondary Substation (CSS)	2.4 – 40.5kV Typical rating (kVA): up to 3150 kVA	IEC, ANSI	MV switchgear, transformer, LV switchboard	Versatile configurations and functions with quick setup and pre- engineering



Industrial fleet

Industrial fleet






Combination of overnight and fast charging, depending on application

- As battery technology advances, major truck and heavy duty vehicle manufacturers are already releasing their line up of low-noise, low-carbon producing electric vehicles.
- These high-power vehicles need high power infrastructure, with a strong focus on safety, especially in critical environments such as mining or for autonomous driving applications
- Charge time can range between 10 minutes to 3 hours.
- Charging power is between 50kW to 600kW.
- Supported connection to electric vehicle
 - Cable connector
 - Pantograph up and down
 - Customized connectors, such as pin-type plugs



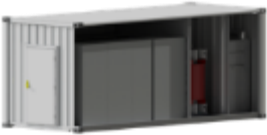



Industrial fleet

Integrated solution

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	CSS with HP chargers	2.4 – 40.5kV Typical rating (kVA): up to 2000 kVA		IEC, ANSI	MV switchgear, HP charger LV switch board, transformers	Skid-mounted, ideal for highway rest areas, immediate charger installs

Industrial fleet



Battery energy storage building blocks

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Industrial fleet

Electrical infrastructure building blocks

		Voltage rating	Applicable standards	Standard components	Key solution features
	Multi-module EcoFlex	Up to 40.5 kV	IEC, ANSI	MV switchgear, transformers, UPS, LV connections, battery rack, charger, RTU	Modular solution, scalable design for futureproofing, fast installation
	Compact Secondary Substation (CSS)	2.4 – 40.5kV Typical rating (kVA): up to 3150 kVA	IEC, ANSI	MV switchgear, transformer, LV switchboard	Versatile configurations and functions with quick setup and pre-engineering

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Commercial fleet

Commercial fleet






Overnight charging

- In addition to improving corporate sustainability, migrating to an electrical vehicle fleet can generate significant operational savings
- Many governments are offering taxation benefits and upfront grants for the purchase of electric vehicles
- Typically fleets are parked overnight and 6-8 hours charging time with a lower power charger is sufficient
- Charging power is typically between 11-24kW, depending on the size of vehicle battery
- Larger fleets requiring many chargers can require larger grid connection and battery storage solutions



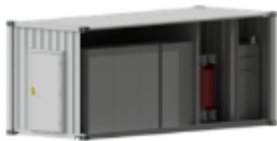



Commercial fleet

Integrated solution

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with HP chargers	Up to 1kV		IEC, ANSI	LV protection equipment, energy management system, high power charging posts	Expandable uses with ES and HP chargers, quick start from LV connection, movable
	CSS with HP chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV switchboard, HP chargers	Quick setup solution for plug-and-play charging requirements
	UniSub with HP chargers	Up to 1kV		IEC, ANSI	LV switchboard, HP chargers	For plug-and-play charging requirements with only LV connection, visually appealing
	EcoFlex w/ energy storage & HP chargers	2.4 – 40.5kV	Up to 400kW/400kWh	IEC, ANSI	MV switchgear, transformer, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	EcoFlex w/ LV distribution & HP chargers			IEC, ANSI	LV distribution, 8 power modules or 4 power modules and 2 charging posts	Quick setup; plug-and-play solution, reduced site works, standard connection interfaces



Commercial fleet

Battery energy storage building blocks

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with energy storage	2.4 – 40.5kV Typical rating (kVA): up to 2000 kVA	Up to 1800kW/1800kWh	IEC, ANSI	MV switchgear, transformers, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	CSS with energy storage	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA	Up to 1000kW/1000kWh	IEC, ANSI	MV switchgear, transformers, LV circuit breakers, energy storage	Ideal for scalable solutions with power demand buffering and energy backup
	EcoFlex w/ energy storage & HP chargers	2.4 – 40.5kV	Up to 400kW/400kWh	IEC, ANSI	MV switchgear, transformer, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	EcoFlex Energy Storage Module	Up to 1kV	Up to 500kW/500kWh	IEC, ANSI	LV switchboard, energy storage	Plug-and-play low voltage energy storage solution, easy to ship and set up

Commercial fleet

Electrical infrastructure building blocks

		Voltage rating	Applicable standards	Standard components	Key solution features
	EcoFlex	2.4 – 40.5kV Typical rating (kVA): up to 4000 kVA	IEC, ANSI	MV switchgear, transformers, LV circuit breakers	Designed for transport, remote locations, fast installation, expandable uses including energy storage
	Compact Secondary Substation (CSS)	2.4 – 40.5kV Typical rating (kVA): up to 3150 kVA	IEC, ANSI	MV switchgear, transformer, LV switchboard	Versatile configurations and functions with quick setup and pre- engineering



Roadside stations

Roadside stations







The fastest car charging application

- Addresses consumer concern about range anxiety requires the introduction of fast charging stations
- Consumers want to charge as fast as possible in the shortest amount of time in these locations
- Typical charging power is between 50kW to 350kW.
- In 10 minutes time:
 - A 50 kW charger can add typically 40-60km
 - A 350 kW charger can add typically 290-350km
- These applications typically require a MV connection to the grid
- Relocatable battery energy storage solutions typically reduce the amount of time needed for permits, offering the fastest deployment for establishing a loyal customer base



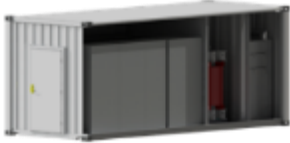



Roadside stations

Integrated solution

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with HP chargers	Up to 1kV		IEC, ANSI	LV protection equipment, energy management system, high power charging posts	Expandable uses with ES and HP chargers, quick start from LV connection, movable
	CSS with HP chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV switchboard, HP chargers	Quick setup solution for plug-and-play charging requirements
	Unisub with HP chargers	Low voltage connection		IEC, ANSI	LV switchboard, HP chargers	For plug-and-play charging requirements with only LV connection, visually appealing
	CSS with fast chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV, fast chargers	Skid mounted, fast installation, ideal for small public or private charging
	CSS with HP chargers	2.4 – 40.5kV Typical rating (kVA): up to 2000 kVA		IEC, ANSI	MV switchgear, HP charger LV switch board, transformers	Skid-mounted, ideal for highway rest areas, immediate charger installs
	EcoFlex w/ LV distribution & HP chargers			IEC, ANSI	LV distribution, 8 power modules or 4 power modules and 2 charging posts	Quick setup; plug-and-play solution, reduced site works, standard connection interfaces

Roadside stations

Battery energy storage building blocks

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with energy storage	2.4 – 40.5kV Typical rating (kVA): up to 2000 kVA	Up to 1800kW/1800kWh	IEC, ANSI	MV switchgear, transformers, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	EcoFlex with energy storage & fast chargers	Up to 1kV	200kWh/200kW - 900kWh/900kW	IEC, ANSI	LV switchboard transformers, energy storage, solar, fast chargers	Solar roof, energy storage for fast charging with LV grid connection, relocatable
	EcoFlex w/ energy storage & HP chargers	2.4 – 40.5kV	Up to 400kW/400kWh	IEC, ANSI	MV switchgear, transformer, LV switchboard, energy storage	Easy to ship and install, BESS for reliable power and peak power demand control
	EcoFlex Energy Storage Module	Up to 1kV	Up to 500kW/500kWh	IEC, ANSI	LV switchboard, energy storage	Plug-and-play low voltage energy storage solution, easy to ship and set up



Roadside stations

Electrical infrastructure building blocks

		Voltage rating	Applicable standards	Standard components	Key solution features
	Compact Secondary Substation (CSS)	2.4 – 40.5kV Typical rating (kVA): up to 3150 kVA	IEC, ANSI	MV switchgear, transformer, LV switchboard	Versatile configurations and functions with quick setup and pre- engineering



Public commercial parking

Public commercial parking

EV charging brings new business growth opportunities






Offering EV charging to your customers:

- Attracts new, loyal, and typically higher earning, customers to stores
- Increases sales as consumers spend more time in stores while their cars are charging
- Supports new business models, such as a loyalty points program – free charges for points earned from in-store purchases
- Helps to decrease the environmental footprint in the community
- Additional revenue generation possibilities with per-charge pricing or on-charger advertising
- Typical charging time can be between 20 minutes to 3 hours, depending on the type of business
- Typical charging power is between 11kW and 50kW







Public commercial parking

Integrated solution

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with HP chargers	Low voltage connection		IEC, ANSI	LV protection equipment, energy management system, high power charging posts	Expandable uses with ES and HP chargers, quick start from LV connection, movable
	CSS with HP chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV switchboard, HP chargers	Quick setup solution for plug-and-play charging requirements
	UniSub with HP chargers	Low voltage connection		IEC, ANSI	LV switchboard, HP chargers	For plug-and-play charging requirements with only LV connection, visually appealing
	CSS with fast chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV, fast chargers	Skid mounted, fast installation, ideal for small public or private charging
	EcoFlex with energy storage & fast chargers	Low voltage connection	200kWh/200kW - 900kWh/900kW	IEC, ANSI	LV switchboard transformers, energy storage, solar, fast chargers	Solar roof, energy storage for fast charging with LV grid connection, relocatable

Public commercial parking

Battery energy storage building blocks

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
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	EcoFlex with energy storage & fast chargers	Up to 1kV	200kWh/200kW - 900kWh/900kW	IEC, ANSI	LV switchboard transformers, energy storage, solar, fast chargers	Solar roof, energy storage for fast charging with LV grid connection, relocatable
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	EcoFlex Energy Storage Module	Up to 1kV	Up to 500kW/500kWh	IEC, ANSI	LV switchboard, energy storage	Plug-and-play low voltage energy storage solution, easy to ship and set up

Public commercial parking

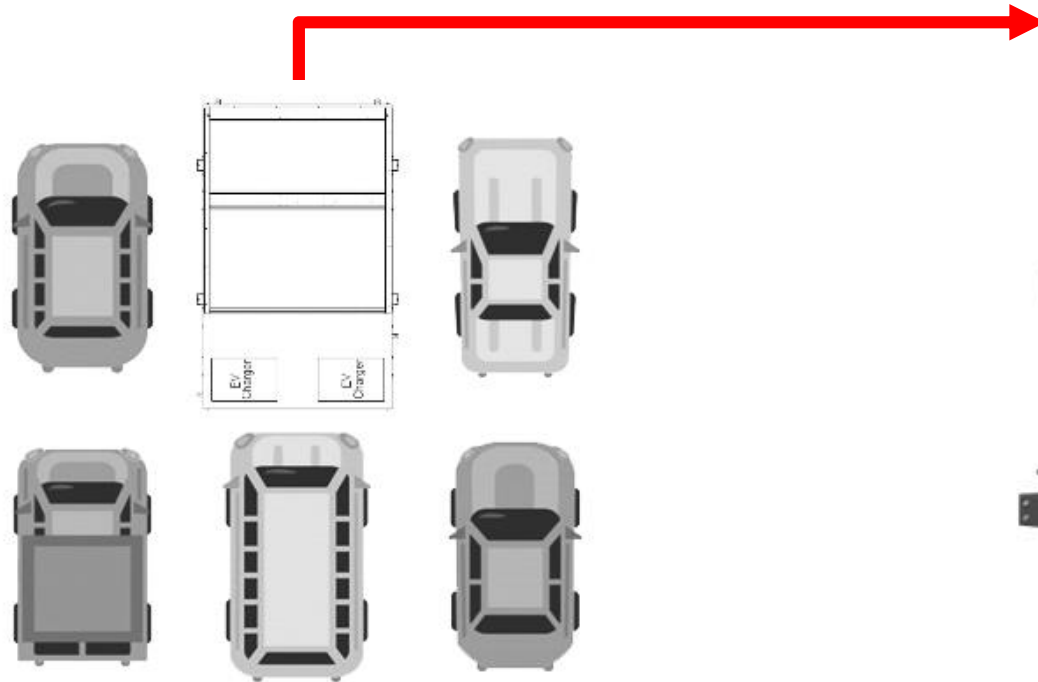
Electrical infrastructure building blocks

		Voltage rating	Applicable standards	Standard components	Key solution features
	Compact Secondary Substation (CSS)	2.4 – 40.5kV Typical rating (kVA): up to 3150 kVA	IEC, ANSI	MV switchgear, transformer, LV switchboard	Versatile configurations and functions with quick setup and pre- engineering

E-mobility public parking applications

Compact Secondary Substation solutions

Our skidded arc-certified CSS solution with chargers can fit into one parking space and charge up to 5 vehicles



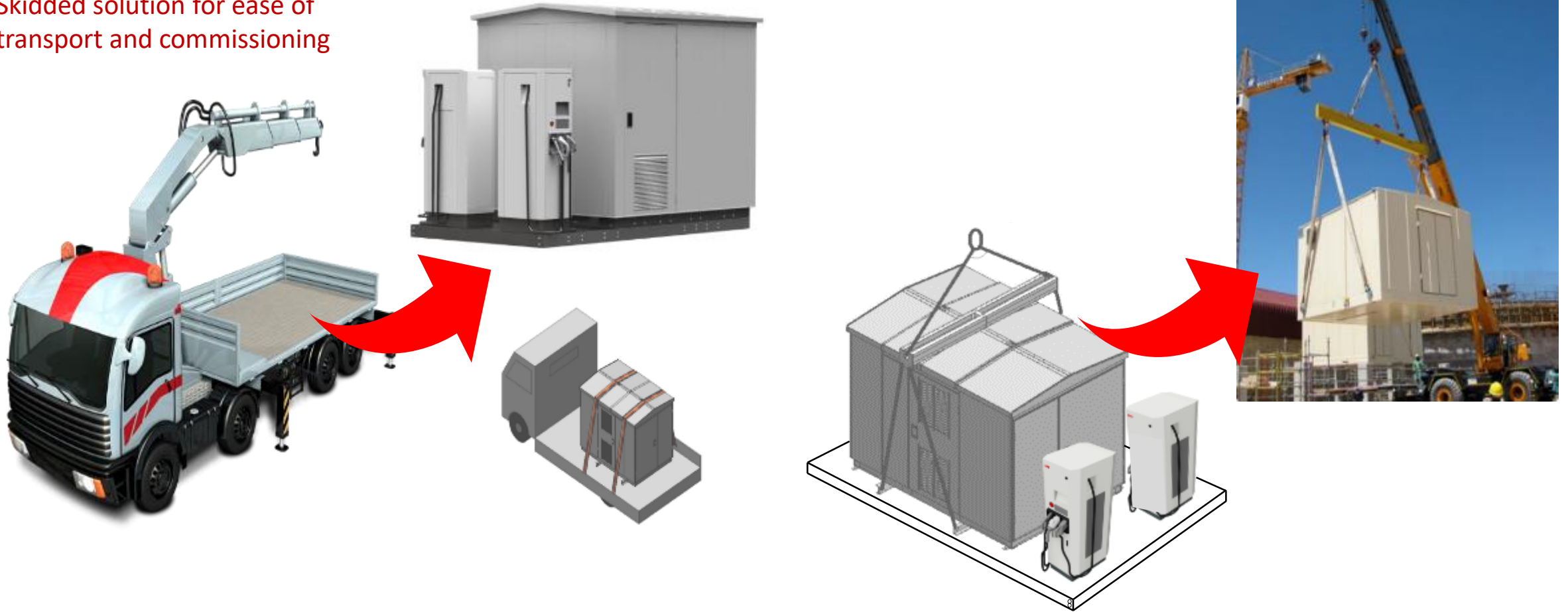
Car parking dimensions



E-mobility public parking applications

Benefits of Compact Secondary Substations

Skidded solution for ease of transport and commissioning



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Apartment, hotel and workspace charging

Apartment, hotel and workplace charging



EV charging for day and night parking

- An increased interest to reduce pollution is driving consumers to make more environmentally-friendly choices in how they live and where they work
- Building owners have the possibility to attract new tenants by offering smart, electric vehicle charging
- Typically cars are parked in these applications 6+ hours or more
- Lower charging power is usually sufficient, such as 3 kw to 22 kW. However, the number of chargers in these applications will increase with the growing demand of electric vehicles.
- With pre-engineered modular infrastructure solutions, building owners can invest in 1 or 2 chargers immediately and scale up later as more consumers adopt electric vehicles






Apartment, hotel and workplace charging

Integrated solution

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
	EcoFlex with energy storage and fast chargers	Up to 1kV	200kWh/200kW - 900kWh/900kW	IEC, ANSI	LV switchboard transformers, energy storage, solar, fast chargers	Solar roof, energy storage for fast charging with LV grid connection, relocatable
	CSS with fast chargers	2.4 – 40.5kV Typical rating (kVA): up to 1250 kVA		IEC, ANSI	MV switchgear, transformer, LV, fast chargers	Skid mounted, fast installation, ideal for small public or private charging

Apartment, hotel and workplace charging

Battery energy storage building blocks

		Voltage rating	Power rating	Applicable standards	Standard components	Key solution features
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Apartment, hotel and workplace charging

Electrical infrastructure building blocks

		Voltage rating	Applicable standards	Standard components	Key solution features
	EcoFlex	2.4 – 40.5kV Typical rating (kVA): up to 4000 kVA	IEC, ANSI	MV switchgear, transformers, LV circuit breakers	Designed for transport, remote locations, fast installation, expandable uses including energy storage

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Other considerations

Things to consider when selecting the proper electrical infrastructure

Enclosures are specific to power requirements and site considerations.
Below you will find detailed information on selecting the right enclosure.

Solutions

CSS family: Internally arc tested to meet IEC62271-202 standard making it ideal for public spaces



EcoFlex eHouse: Internally arc tested and easy to transport and relocate



Open-air skid: Ideal pre-assembled, pre-tested solution for quick installation and simple maintenance



Site considerations	CSS	EcoFlex	Open-air skid	
Public space	+++	++		+ Good ++ Better +++ Best
Environmental (moisture, salt, fog, etc.)	+++ (GRP) ++ (Steel)	++	+	
Seismic	++	++	++	
Wind	++	+++		
High Altitude	++	+++	+	
Arc containment	+++	+++		
Transportability	++	+++	++	
Relocatable	+	+++	+	
Compactness	++	+	+++	

Advantages of integrated skid-mounted, complete solutions

Eliminate time and cost

For simple, quick installation consider placing high power chargers on the same skid with the enclosure to eliminate:

- Placing the enclosure behind a fence
- Cabling and cable trays costs
- Installation costs

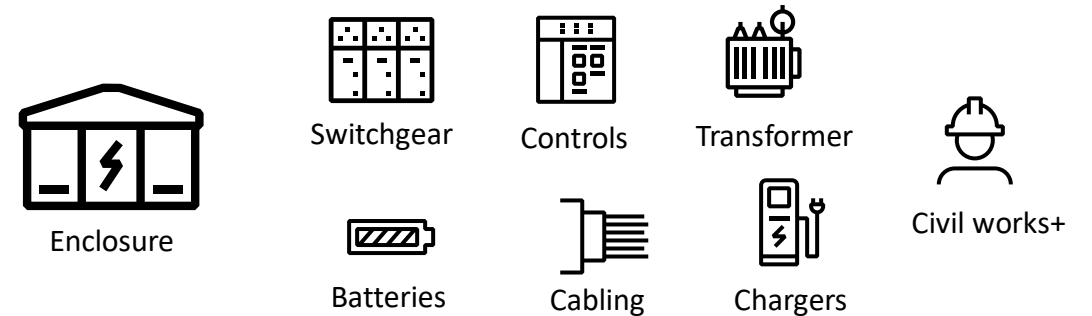


Integrated solution provides simple, quick installation



versus

Individual product delivery



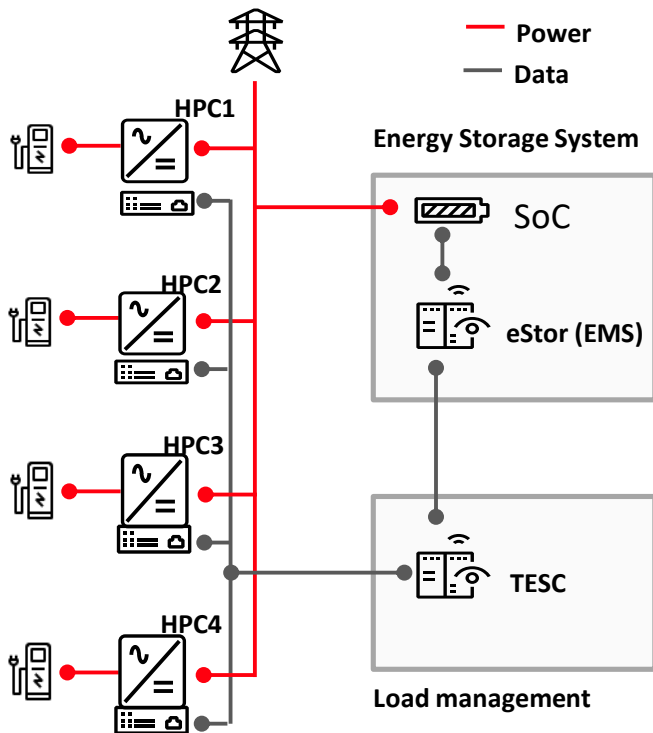


Digital options

Digital controls to solve grid constraint issues

Synchronized charging digital solutions

Synchronized charging for e-mobility



Grid constraints can often limit placement of eV charging locations or require long permitting times and infrastructure improvements.

However, with the addition of a Battery Energy Storage Systems (BESS) performing peaking capacity and the eV site controller performing load management, customers are able to synchronize charging for optimized energy flows in order to:

- Keep the grid under the capacity limit
- Provide maximum power to the eV customers
- Deploy eV charging infrastructure more quickly and to test possible locations before investing in costly grid capacity and electrical distribution expansions

Energy storage and synchronized charging digital solutions

Advantages



The energy storage and controlled synchronization allows customer to charge more than their existing power limit on the grid, this is specifically important when facing grid limitation issues.



It can take up to 1 year to obtain permits needed to deploy permanent charging infrastructure. The permits needed for a temporary installation are easier and faster to obtain. This allows a charge station to be deployed quickly and buys more time for the necessary permits to be collected for the permanent charging station. The temporary solution can then be relocated to the next planned site.



The solution allows a possible location to be tested before investing in costly grid capacity and electrical distribution expansions.



This solution prevents undervoltage issues and nuisance trips



The synchronization and voltage control helps prevent frequency excursions



The system can automatically detect load and synchronize



Why choose ABB for your e-mobility needs?

ABB Electrification is your total solution for e-mobility

A one-stop-shop



**EV chargers for cars,
buses and fleets**



**E-mobility
infrastructure solutions**



**Financing for
e-mobility solutions**



**ABB can help make your
investments scale with needed
capacity**



**ABB can help install your
electrical vehicle infrastructure in
over 80 countries**



**ABB will service and maintain
the infrastructure for optimal
use and availability**



**We will help you design, install
and service your investment**

ABB Packaging and Solutions for your e-mobility infrastructure needs

The perfect partner



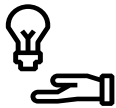
Trustworthy partner

ABB is a global partner with a focus on advanced technologies



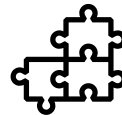
Ensure operability

Pre-engineered, pre-assembled and pre-tested solutions reduces risk



High reliability

Our solutions have undergone extensive risk and failure mode analysis



Flexible modular concept

Modular concept allows for ease of scalability in power and capacity



Safe, easy to install and operate

Pre-assembled and tested at ABB premises to ensure personnel safety and reduce time on-site

Maximize your ROI with highly reliable, scalable and safe solutions

Consider ABB Packaging & Solutions for your e-mobility solution needs

The perfect partner

Trustworthy partner



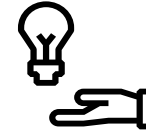
- World leader in digital industries to serve customers
- Pioneering technology leader focused on digital industries
- Strong global team

Ensure operability



- Pre-engineered and industrialized products with reduced project engineering
- Reduced installation and transportation costs
- Maximize uptimes with factory assembled and pre-tested solutions
- Ensures immediate operability
- Can be dropped in parking space – ready to work

High reliability

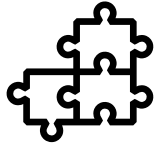


- Protect equipment from environmental influences
- Factory tested solution
- Designed to withstand severe environmental conditions
- Undergone extensive risk and failure mode analysis
- Advanced and efficient temperature control provided for the inverter and battery system.
- IEC compliant

Consider ABB Packaging and Solutions for your e-mobility solution needs

The perfect partner

Flexible



- Modular concept to allow ease of scalability in power and capacity
- From low-voltage to a wide range of AC medium-voltage levels
- Engineered footprint to optimize customer's requests
- Different options of MV switchgear from ABB's SF₆ gas-insulated secondary switchgear portfolio (also available with air-insulated switchgear)

Safe and easy to install and operate



- Internally arc tested for public and service personnel
- No live parts accessible
- Locking system for all enclosure doors prevents unauthorized entry of personnel
- Local and remote monitoring and control, easy integration to customer SCADA and ABB Ability™
- Ease of transportation due to standardize solutions
- Pre-assembled and tested at ABB premises to reduce on-site times
- 24/7 service support available to ensure uptime

Partnering with an expert is critical to success

ABB is a leader in delivering EV charging and electrical infrastructure

The standards for EV charging infrastructure are evolving

- ABB is a founding member to CHAdeMO and CCS standards and are co-developing the next advancements, such as ultra-fast charging solutions.

Interoperability between EV charger and the electric vehicle is not universal

- ABB offers an interoperability consultancy, working directly with all of the major car and bus OEMs to ensure successful interaction between your chosen vehicle and ABB EV chargers.

ISO 15118 can be utilized for advanced services, such as preconditioning

- Allows the vehicle cabin to be brought to the perfect temperature prior to departure from depot, saving valuable battery capacity.
- On-site connectivity solutions can be used to integrate chargers in local control systems, such as for fleet scheduling and energy management.

Cloud-based connectivity is critical:

- To ensure chargers are always working with the latest electric vehicles, software updates are delivered remotely
- To extend charging to public use-case, such as setting up pricing for charge sessions, to accept credit card payments, to authorize new vehicles to use the chargers
- To analyze charging statistics for business insights, such as trends in charging schedule, energy usage, and for testing new business models
- For evaluating the health of the EV chargers, such as any alerts or warnings, and using predictive maintenance to prevent disruption to charging operations

ABB



Detailed solutions

Compact Secondary Substation (CSS)

E-mobility modular systems product selection

- The CSS is a versatile product available in multiple materials (GRP or steel), in multiple configurations, with a variety of footprints, and above all, type tested to withstand internal arc according IEC 62271-202.
- These characteristics make the compact secondary substation the most flexible solution for the IEC market.

Key specifications

Medium voltage level from 2.4 - 40.5 kV

Typical ratings (kVA): up to 3150 kVA

Secondary voltage: 400-480 V

Transformer type: Oil or dry

Protection degree: IP 43 (MV SWGR/transformer)

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Available in multiple configurations, sizes and materials



Pre-engineered product to minimize project engineering



Simple and quick installation



Internally arc tested, to provide improved safety



CSS with integrated High Power chargers

E-mobility modular systems product selection

- The e-mobility CSS with integrated high power chargers provides many benefits for bus overhead charging in a single piece delivery.
- This solution embeds all the features of ABB's CSS family, i.e. internally arc tested, so it's safe for public areas and it also provides the security of having the chargers enclosed in a lockable housing.
- Pre-wired and pre-tested at the factory to minimize site activities, like excavation and civil works.

Key specifications

Medium voltage level from 2.4 - 40.5 kV

Typical ratings (kVA): up to 1250 kVA

Secondary voltage: 400-480 V

Protection degree: IP 54/23D (MV SWGR/transformer)

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Typically designed for overhead bus charging



Reduced site activities



Pre-assembled and wired solution, to minimize site works



Internally arc tested, to provide improved safety



CSS with Energy Storage Module

E-mobility modular systems product selection

- The e-mobility CSS solution with integrated energy storage provides power to high power cabinets; such power comes from the grid, and, when grid power is insufficient to cover the demand, the stored energy flows in parallel to meet the chargers power demand.
- Typical application is the peak power demand control, that is to say, the power delivery in parallel to the grid, when necessary.
- Internal arc testing provides improved safety for people and goods.

Key specifications

Medium voltage level from 2.4 - 40.5 kV

Typical ratings (kVA): up to 1250 kVA

Secondary voltage: 400-480 V

Protection degree: IP 54/23D (MV SWGR/transformer)

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Available in multiple configurations, sizes and materials



Pre-assembled and wired solution, to minimize site works



Simple and quick installation



Internally arc tested, to provide improved safety



UniSub with integrated HP chargers

E-mobility modular systems product selection

- UniSub Terra HP is a housing that can accommodate from 2 to 8 Terra HP power cabinets.
- It has been developed to provide to comply with aesthetical canons/regulations.
- It also dampens the high frequency noise of the HP power charging cabinets.

Key specifications

Available for 4 to 8 Terra HP power cabinets

Available in metal or GRP, with external wooden cladding

Protection degree: IP 23D (it encloses IP 54 equipment)

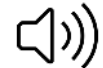
Provided with internal net to avoid wild animal intrusion



Green solution: built with recyclable material to minimize environmental impact



Sustainable design, can be equipped with green grass roof



Reduces the high frequency noise of the power converters



Easy to install, limited site works



Skid mounted CSS with integrated fast chargers

E-mobility modular systems product selection

- Skid mounted CSS plus Terra 54 is a plug-and-play product that can provide a DC charging station in one day of site works.
- This solution is the same size as a car and therefore can be placed in a regular parking area, taking up only one car parking space.
- This solution embeds all the features of ABB CSS family, is internal arc tested and features the advantages of a GRP enclosure.
- Additional Terra 54 chargers can be connected and placed nearby to extend the charging station.

Key specifications

Medium voltage level from 2.4 - 40.5 kV

Typical ratings (kVA): up to 1250 kVA

Secondary voltage: 400-480-690 V

Protection degree: IP 43/54 (MV SWGR/transformer)

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Plug-and-play solution, connect to grid and start operation



Same size as a car to be installed in a car parking space



Ease of handling, transportation, unloading and connection



Internally arc tested, to provide improved safety



Skid mounted CSS plus HP charger power cabinets

E-mobility modular systems product selection

- Skid mounted CSS plus Terra HP provides multiple values in a single piece delivery.
- This pre-wired, easy to install, internally arc tested solution drastically reduces the site activities in terms of man-hours, excavation and civil works activities.
- Cabling to charge posts can be easily connected to the junction box besides the HP cabinets.

Key specifications

Medium voltage level from 2.4 - 40.5 kV

Typical ratings (kVA): up to 2000 kVA

Secondary voltage: 400-480 V

Transformer type: Oil or dry

Protection degree: IP 43/54 (MV SWGR/transformer)

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Pre assembled and wired solution, to minimize site works



Simple and quick installation, limited site work



Reducing site activities it implies reduction of safety related risks



Internally arc tested, to provide maximum safety



EcoFlex eHouse

E-mobility modular systems product selection

- The EcoFlex eHouse product range is ideal when higher power is needed.
- The enclosed substation holds all of the electrical equipment needed to step down the voltage from medium to low voltage.
- A typical application is the eBus depot, where a large number of eBuses are charged simultaneously overnight.

Key specifications

Medium voltage level from 2.4 - 40.5 kV

Typical ratings (kVA): up to 4000 kVA

Secondary voltage: 400-480 V

Transformer type: Oil or dry

Protection degree: IP 43/54 (MV SWGR/transformer)

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Stackable solution made of iso standard enclosures, can be expandable



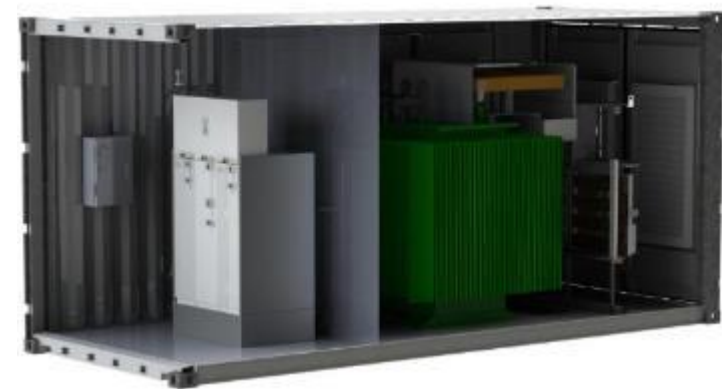
Easy to ship, load and download



Robust and scalable solution, several EcoFlex modules can be combined together



Relocatable solution adapt for temporary power needs



EcoFlex eHouse with energy storage and HP chargers

E-mobility modular systems product selection

- This EcoFlex eHouse design includes the electrification components, energy storage and the charging power cabinets.
- This solution is ideal for providing high power charging where grid power is insufficient.
- A typical application is the connection to the LV grid, where no MV connection is available and the peak power demand isn't manageable.

Key specifications

Power up to 400 kW (20 feet solution)

Storage capacity up to 400 kWh (20 feet solution)

Number of power cabinet: 4 (20 feet solution)

Rated voltage: 400 Vac

Protection degree: IP 43/54 (MV SWGR/transformer)

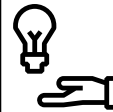
Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



This solution provides power where needed, regardless of MV connection



Easy to ship, load and download



Pre engineered solution, pre tested and assembled



Relocatable solution adapt for temporary power needs



EcoFlex with energy storage, HP chargers and solar

E-mobility modular systems product selection

- This all-in-one solution in the EcoFlex design provides the electrification, energy storage and the charging power cabinets.
- This solution, in addition to the previous one, also provides PV generation, thanks to its green concept, and pre-installed charge posts.
- This is a plug-and-play solution able to provide 350 kW of charging power due to the energy stored.

Key specifications

Power up to 900 kW (40 feet solution)

Storage capacity up to 1000 kWh (40 feet solution)

Number of power cabinet: 4 (40 feet solution)

Rated voltage: 400 Vac

Protection degree: IP 54 MV SWGR / IP 45 Transformer

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Plug and play solution, connect to grid and start operation



Simple and quick installation



Pre engineered solution, pre tested and assembled



Relocatable solution adapt for temporary power needs



EcoFlex eHouse with HP chargers

E-mobility modular systems product selection

- This EcoFlex eHouse design includes low voltage connection equipment and charging power cabinets.
- This solution can include stationary or withdrawable charging posts for low voltage connection charging.
- This is a plug-and-play solution able to provide up to 4 EV charging posts and anywhere from 2 to 8 EV charger power cabinets.

Key specifications

Available Charging Power: Up to 8 x 173kW

Number of power cabinet: 2 to 8

Rated voltage: 400-480 V

Protection degree: IP 54 LV Switchboard

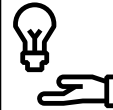
Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Improved Safety of type tested equipment that's easy to install



Easy to ship, load and offload



Maximize ROI with pre engineered and pre tested solution



Relocatable solution adapt for temporary power needs



EcoFlex eHouse with LV distribution and high-power charging w/ optional charge posts

E-mobility modular systems product selection

- This EcoFlex eHouse design includes low voltage connection equipment and charging power cabinets.
- This solution can include stationary or withdrawable charging posts for low voltage connection charging.
- This is a plug-and-play solution able to provide up to 8 power cabinets or 4 power cabinets with 2 charging posts.

Key specifications

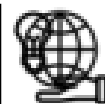
Available Charging Power: Up to 1400kW

Number of power cabinet: 4 or 8

Rated voltage: 400-480 V

Protection degree: IP 54 LV Switchboard

Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Standard connection interface between power modules, chargers and grid for easy start up and expansion



Easy to ship, load and offload



Maximize ROI with pre-engineered and pretested solution



Relocatable solution adapt for temporary power needs



EcoFlex Energy Storage Module

E-mobility modular systems product selection

- This EcoFlex eHouse design includes low voltage connection equipment and energy storage flexibility
- The Very mobile design allows for a quick hookup to existing systems to allow for immediate energy storage availability.
- This is a plug-and-play solution houses the inverter, batteries, energy management system, protection equipment, cabling, HVAC and fire suppression system.

Key specifications

Typical Ratings: Up to 500kVA

Power up to 500kW

Storage capacity up to 500kWh

Rated voltage: 400-480 V

Protection degree: IP 54 LV Switchboard/ IP 23 Transformer

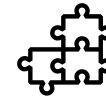
Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more



Plug and play solution,
connect to grid and start
operation



Easy to ship, load and offload



Modular system for easy
extension of power capacity



Relocatable solution adapt
for temporary power needs

