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
Global EV outlook

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

Emission regulations getting tighter and tighter

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

Source: BloombergNEF

Source: BloombergNEF
Trend towards bigger cars with higher power requirements

DC high-power charging CCS (≥150 kW @800V)

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

DC fast charging CCS (50-150 kW @400 V)

DC fast charging CHAdeMO (50-150 kW @400 V)

AC fast charging 43 kW

AC 22 kW OBC

AC 11 kW OnBoardConverter

Only AC slow (3.6-7.2 kW)

Power requirements are increasing

©ABB
May 6, 2020 | Slide 6
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 overnight

**eBus en route charging**
- Medium Voltage
- Typically 10-20 mins

**Industrial fleet**
- Medium Voltage
- Typically overnight

**Commercial fleet**
- Medium Voltage
- Typically overnight

**Roadside stations**
- 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 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 + Faster charging times

**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

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

Overnight charging
8+ hours

High power charging
10-20 mins
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

<table>
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<th>Public and commercial EV Charging</th>
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<td><strong>AC destination</strong></td>
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<td>3-22 kW</td>
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<tr>
<td>4-16 hours</td>
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- Office, workplace
- Home
- Multi-family housing
- Hotel and hospitality
- Overnight fleet
- Supplement at DC charging sites for PHEVs

- Office, workplace
- Hotel and hospitality
- Parking structures
- Dealerships
- Urban fleets
- Public or private campus
- Sensitive grid applications

- Retail, grocery, mall, big box stores, restaurant
- High turnover parking
- Convenience fueling stations
- Highway truck stops and travel plazas
- OEM R&D

- Bus depot charging private campus
- Specific bus fleet hard & software
- High number of units
- Central bus depots and bus-line turning point

- Highway corridor travel
- Metro “charge and go”
- Highway rest stops
- Petrol station areas
- City ring service stations
- OEM R&D
E-mobility solutions landscape for cars and fleets

ABB has a complete portfolio of EV chargers span across multiple charging applications

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Alternate use-cases for depots
E-mobility solutions landscape for DC charging

Typical topologies available for car and fleet charging

**DC destination charging**
- DC charging up to 25 kW
- Substation up to 1250 kVA
- Charging time 1 – 3 hours
- Ideal for multi-family homes, offices, urban fleets, dealerships, hotels, and parking structures

**DC fast charging**
- DC chargers up to 50-180 kW
- Substation up to 1250 kVA
- Charging time 20 – 90 mins
- Ideal for retail, malls, high turnover parking, highway truck stops

**DC high power (HP) charging**
- High power charging up to 350 kW
- Substation up to 2MVA
- Charging time 10 – 20 mins
- Ideal for highway corridors and rest stops as well as heavy vehicles

**Fleet or depot charging**
- Fleet or e-bus charging up to 175 kW
- Substation up to 4 MVA
- Ideal for overnight fleet or bus charging requirements
E-mobility and energy storage solutions landscape

For this presentation, we will focus on the following types of e-mobility infrastructure:

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<tr>
<th>Type</th>
<th>Power Range</th>
<th>Time</th>
<th>Applications</th>
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</table>
| **DC Fast**                 | 50-180 kW         | 20-90 min | - Retail, grocery, mall, big box, restaurant  
- High turnover parking  
- Convenience fueling stations  
- Highway truck stops and travel plazas  
- OEM R&D |
| **Depot Charging**          | Several units 50 to 175 kW+ | hours | - Bus depot charging  
  Private campus  
- Specific bus fleet hard & software  
- High number of units  
- Central bus depots and bus-line turning point |
| **DC High Power**           | 150 to 350 kW+    | 10-20 min | - Highway corridor travel  
- Metro “charge and go”  
- Highway rest stops  
- Petrol stations  
- City ring service stations  
- OEM R&D |
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

- DC fast chargers
  - Terra systems

- E-bus chargers
  - HVC

- Charging network software services
  - ABB Ability

- Service
  - Asset management
  - Extensions, upgrades, retrofits
  - Installation, commissioning

- Energy storage
  - ESM

- Electrical power
  - Integrated electrical and charging

- Components
  - DIN rail, distribution boards
  - Switchgear, switchboards

- Distribution Solution Components
  - LV and MV switchgear
  - Relays

- Electrical power
  - Electrical only

- Renewable integration
  - Solar, wind
ABB Electrification Packaging and Solutions
Providing the building blocks needed for your electrification, energy storage and charging needs

The Packaging and Solutions group offers:

– Pre-engineered product packages
– Customized eHouses, skids and mobile substations
– Standardized eHouses and skids
– Compact Secondary Substations (CSS)
– Energy Storage Modules (ESM)
– Integrated electrical and charger solutions
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.

The ability to place this solution in public spaces can save 30% on installation costs — no fencing or security required.
Offering by application

**Bus depot**
- Medium Voltage
- Typically 8 hours overnight

**Road-side stations**
- Medium Voltage
- Typically 10-20 min

**eBus en route charging**
- Medium Voltage
- Typically 10-20 mins

**Public commercial parking**
- Medium Voltage
- Typically 20-90 min

**Industrial fleet**
- Medium Voltage
- Typically 8 hours overnight

**Office/apartment charging**
- Low Voltage
- Typically 8 hours

**Commercial fleet**
- Medium Voltage
- Typically 8 hours overnight

**Residential Charging**
- Low Voltage
- Typically 8 hours overnight
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

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<tr>
<th></th>
<th>Voltage rating</th>
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<th>Key solution features</th>
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<td>Up to 1kV</td>
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<td>IEC, ANSI</td>
<td>LV protection equipment, energy management system, high power charging posts</td>
<td>Expandable uses with ES and HP chargers, quick start from LV connection, movable</td>
</tr>
<tr>
<td>UniSub with HP chargers</td>
<td>Low voltage connection</td>
<td></td>
<td>IEC, ANSI</td>
<td>LV switchboard, HP chargers</td>
<td>For plug-and-play charging requirements with only LV connection, visually appealing</td>
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# Battery energy storage building blocks

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<th><strong>Voltage rating</strong></th>
<th><strong>Power rating</strong></th>
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<tr>
<td></td>
<td>2.4 – 40.5kV</td>
<td>Up to 1800kW/1800kWh</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformers, LV switchboard, energy storage</td>
<td>Easy to ship and install, BESS for reliable power and peak power demand control</td>
</tr>
<tr>
<td><strong>CSS with energy storage</strong></td>
<td>2.4 – 40.5kV</td>
<td>Up to 1000kW/1000kWh</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformers, LV circuit breakers, energy storage</td>
<td>Ideal for scalable solutions with power demand buffering and energy backup</td>
</tr>
<tr>
<td><strong>EcoFlex Energy Storage Modules</strong></td>
<td>Up to 1kV</td>
<td>Up to 500kW/500kWh</td>
<td>IEC, ANSI</td>
<td>LV switchboard, energy storage</td>
<td>Plug-and-play low voltage energy storage solution, easy to ship and set up</td>
</tr>
</tbody>
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# Bus depot

## Electrical infrastructure building blocks

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

Value proposition and customer benefits

<table>
<thead>
<tr>
<th>Digitalization</th>
<th>Low and medium voltage power</th>
<th>High power chargers</th>
</tr>
</thead>
</table>

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

- **Depot charging box**
- **MNS® LV Switchgear**
- **HVC power cabinet**

**Key features:**
- **44** ABB 150C Heavy Vehicle Charging Systems
- **150 kW** Charging Power per Charging System
- **110** Bus lines and more than 921 km of distance
- **>213 Mio.** Passengers every year
- **100%** Total electrification of fleet until 2030
- **83,000 t** Zero emissions in bus and tram fleets until 2030

ABB HVC 150-C

**ABB 150C Heavy Vehicle Charging Systems**

**RESIBLOC® Transformer**

**SafePlus MV Switchgear**

**Depot-Boxes for smallest footprints**

**Flexible positioning of Power Units**

**Lost space**
E-mobility solutions for high power depot applications

Simulation of reference case implementation
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
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

<table>
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<tr>
<th>Model</th>
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<td>IEC, ANSI</td>
<td>LV protection equipment, energy management system, high power charging posts</td>
<td>Expandable uses with ES and HP chargers, quick start from LV connection, movable</td>
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<td>CSS with HP chargers</td>
<td>2.4 – 40.5kV</td>
<td>Typical rating (kVA): up to 1250 kVA</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformer, LV switchboard, HP chargers</td>
<td>Quick setup solution for plug-and-play charging requirements</td>
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<td>For plug-and-play charging requirements with only LV connection, visually appealing</td>
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<tr>
<td>EcoFlex w/ energy storage &amp; HP chargers</td>
<td>2.4 – 40.5kV</td>
<td>Up to 400kW/400kWh</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformer, LV switchboard, energy storage</td>
<td>Easy to ship and install, BESS for reliable power and peak power demand control</td>
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<td>Bus charging station</td>
<td>2.4 – 40.5kV</td>
<td>Typical rating (kVA): up to 1250 kVA</td>
<td>IEC</td>
<td>MV switchgear, LV circuit breakers, transformers</td>
<td>Single piece delivery, connects to local monitoring</td>
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### eBus en route charging

Battery energy storage building blocks

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<td><strong>Charging station with energy storage</strong></td>
<td>2.4 – 40.5kV</td>
<td>200kWh/200kW – 300kWh/500kWh</td>
<td>IEC</td>
<td>MV switchgear, LV circuit breakers, transformers, energy storage</td>
<td>Ideal for weak grid supply, energy storage, fast installation</td>
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## eBus en route charging

### Electrical infrastructure building blocks

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<td>up to 3150 kVA</td>
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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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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/400k Wh | IEC, ANSI | MV switchgear, transformer, LV switchboard, energy storage | Easy to ship and install, BESS for reliable power and peak power demand control |
| 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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<td>LV switchboard, energy storage</td>
<td>Plug-and-play low voltage energy storage solution, easy to ship and set up</td>
</tr>
</tbody>
</table>
## Industrial fleet

### Electrical infrastructure building blocks

<table>
<thead>
<tr>
<th>Multi-module EcoFlex</th>
<th>Voltage rating</th>
<th>Applicable standards</th>
<th>Standard components</th>
<th>Key solution features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 40.5 kV</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformers, UPS, LV connections, battery rack, charger, RTU</td>
<td>Modular solution, scalable design for futureproofing, fast installation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compact Secondary Substation (CSS)</th>
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<td>Versatile configurations and functions with quick setup and pre-engineering</td>
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</tbody>
</table>
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

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<td>MV switchgear, transformer, LV switchboard, HP chargers</td>
<td>Expandable uses with ES and HP chargers, quick start from LV connection, movable</td>
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<tr>
<td>with HP chargers</td>
<td></td>
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</tr>
<tr>
<td><strong>CSS</strong></td>
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<td>Typical rating (kVA):</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformer, LV switchboard, HP chargers</td>
<td>Quick setup solution for plug-and-play charging requirements</td>
</tr>
<tr>
<td><strong>with HP chargers</strong></td>
<td></td>
<td>up to 1250 kVA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UniSub</strong></td>
<td>Up to 1kV</td>
<td></td>
<td>IEC, ANSI</td>
<td>LV switchboard, HP chargers</td>
<td>For plug-and-play charging requirements with only LV connection, visually appealing</td>
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<tr>
<td><strong>EcoFlex w/ energy storage &amp; HP chargers</strong></td>
<td>2.4 – 40.5kV</td>
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<td>IEC, ANSI</td>
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### Commercial fleet
Battery energy storage building blocks

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<td>2.4 – 40.5kV</td>
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<td>CSS with energy storage</td>
<td>2.4 – 40.5kV</td>
<td>Up to 1000kW/1000kWh</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformers, LV circuit breakers, energy storage</td>
<td>Ideal for scalable solutions with power demand buffering and energy backup</td>
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# Commercial fleet

## Electrical infrastructure building blocks

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<td><strong>EcoFlex</strong></td>
<td>2.4 – 40.5kV</td>
<td>IEC, ANSI</td>
<td>MV switchgear, transformers, LG circuit breakers</td>
<td>Designed for transport, remote locations, fast installation, expandable uses including energy storage</td>
</tr>
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<td></td>
<td>Typical rating (kVA): up to 4000 kVA</td>
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<td><strong>Compact Secondary Substation (CSS)</strong></td>
<td>2.4 – 40.5kV</td>
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<td>Typical rating (kVA): up to 3150 kVA</td>
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</table>
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

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<td><strong>Unisub with HP chargers</strong></td>
<td>Low voltage</td>
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<td>Skid mounted, fast installation, ideal for small public or private charging</td>
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<td></td>
<td>IEC, ANSI</td>
<td>MV switchgear, HP charger LV switch board, transformers</td>
<td>Skid-mounted, ideal for highway rest areas, immediate charger installs</td>
</tr>
</tbody>
</table>

©ABB
May 6, 2020
Slide 46
# Roadside stations

Battery energy storage building blocks

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Public commercial parking
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

EV charging brings new business growth opportunities
## Public commercial parking

### Integrated solution

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Public commercial parking
Battery energy storage building blocks

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## Public commercial parking

**Electrical infrastructure building blocks**

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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.
E-mobility public parking applications

Benefits of Compact Secondary Substations

Skidded solution for ease of transport and commissioning
Apartment, hotel and workspace charging
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.
<table>
<thead>
<tr>
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# Apartment, hotel and workplace charging

Battery energy storage building blocks

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## Apartment, hotel and workplace charging

Electrical infrastructure building blocks

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<td>Typical rating (kVA): up to 4000 kVA</td>
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<td>Designed for transport, remote locations, fast installation, expandable uses including energy storage</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Site considerations</th>
<th>CSS</th>
<th>EcoFlex</th>
<th>Open-air skid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public space</td>
<td>+++</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Environmental (moisture, salt, fog, etc.)</td>
<td>+++ (GRP)</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Seismic</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Wind</td>
<td>++</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>High Altitude</td>
<td>++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Arc containment</td>
<td>+++</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Transportability</td>
<td>++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Relocatable</td>
<td>+</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Compactness</td>
<td>++</td>
<td>+</td>
<td>+++</td>
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</tbody>
</table>

**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
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

Extra cabling and installation costs
E-mobility options
Optional electrical infrastructure selections available

Electrification
Different electrification technologies can be selected:

<table>
<thead>
<tr>
<th>Products</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary substation</td>
<td>Outdoor Skid, CSS, EcoFlex eHouses.</td>
</tr>
<tr>
<td>Transformer</td>
<td>Oil or dry</td>
</tr>
<tr>
<td>MV protection</td>
<td>Gas- or air-insulated, indoor or outdoor, arc and non-arc resistant swgr</td>
</tr>
<tr>
<td>LV protection</td>
<td>LV circuit breaker</td>
</tr>
<tr>
<td>LV switches</td>
<td>InLine 2</td>
</tr>
<tr>
<td>LV breakers</td>
<td>Molded case circuit breaker</td>
</tr>
<tr>
<td>LV cable pillars</td>
<td>Fusegear and cable distribution cabinets</td>
</tr>
<tr>
<td>Energy storage</td>
<td>As needed</td>
</tr>
</tbody>
</table>

Installation types
There are many types of site specific installations including skids, compact secondary substations and EcoFlex eHouses.

Service
After sales services and specific service contracts can be provided covering:
- Mechanical packages
- Electrical solutions
- Control systems
- Charging devices
- SCADA systems

ABB Ability
The packages are ABB Ability enabled
- Electrical equipment can be monitored by a traditional electrical SCADA system for ease of interface between all the electrical equipment.
- The system can also be connected through a broadband cellular network.
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

<table>
<thead>
<tr>
<th>Trustworthy partner</th>
<th>Ensure operability</th>
<th>High reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>– World leader in digital industries to serve customers</td>
<td>– Pre-engineered and industrialized products with reduced project engineering</td>
<td>– Protect equipment from environmental influences</td>
</tr>
<tr>
<td>– Pioneering technology leader focused on digital industries</td>
<td>– Reduced installation and transportation costs</td>
<td>– Factory tested solution</td>
</tr>
<tr>
<td>– Strong global team</td>
<td>– Maximize uptimes with factory assembled and pre-tested solutions</td>
<td>– Designed to withstand severe environmental conditions</td>
</tr>
<tr>
<td></td>
<td>– Ensures immediate operability</td>
<td>– Undergone extensive risk and failure mode analysis</td>
</tr>
<tr>
<td></td>
<td>– Can be dropped in parking space – ready to work</td>
<td>– Advanced and efficient temperature control provided for the inverter and battery system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– IEC compliant</td>
</tr>
</tbody>
</table>
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
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**

<table>
<thead>
<tr>
<th>Medium voltage level from 2.4 - 40.5 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical ratings (kVA): up to 3150 kVA</td>
</tr>
<tr>
<td>Secondary voltage: 400-480 V</td>
</tr>
<tr>
<td>Transformer type: Oil or dry</td>
</tr>
<tr>
<td>Protection degree: IP 43 (MV SWGR/transformer)</td>
</tr>
<tr>
<td>Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

Available in multiple configurations, sizes and materials

Simple and quick installation

Pre-engineered product to minimize project engineering

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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium voltage level</td>
<td>2.4 - 40.5 kV</td>
</tr>
<tr>
<td>Typical ratings (kVA)</td>
<td>up to 1250 kVA</td>
</tr>
<tr>
<td>Secondary voltage</td>
<td>400-480 V</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 54/23D (MV SWGR/transformer)</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium voltage level</td>
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<tr>
<td>Typical ratings (kVA)</td>
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</tr>
<tr>
<td>Secondary voltage</td>
<td>400-480 V</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 54/23D (MV SWGR/transformer)</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Available for 4 to 8 Terra HP power cabinets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available in metal or GRP, with external wooden cladding</td>
</tr>
<tr>
<td>Protection degree: IP 23D (it encloses IP 54 equipment)</td>
</tr>
<tr>
<td>Provided with internal net to avoid wild animal intrusion</td>
</tr>
</tbody>
</table>

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.

**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**

---

**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
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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium voltage level</td>
<td>2.4 - 40.5 kV</td>
</tr>
<tr>
<td>Typical ratings (kVA)</td>
<td>up to 2000 kVA</td>
</tr>
<tr>
<td>Secondary voltage</td>
<td>400-480 V</td>
</tr>
<tr>
<td>Transformer type</td>
<td>Oil or dry</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 43/54 (MV SWGR/transformer)</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

- 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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium voltage level</td>
<td>2.4 - 40.5 kV</td>
</tr>
<tr>
<td>Typical ratings (kVA)</td>
<td>up to 4000 kVA</td>
</tr>
<tr>
<td>Secondary voltage</td>
<td>400-480 V</td>
</tr>
<tr>
<td>Transformer type</td>
<td>Oil or dry</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 43/54 (MV SWGR/transformer)</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

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
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 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Up to 400 kW (20 feet solution)</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>Up to 400 kWh (20 feet solution)</td>
</tr>
<tr>
<td>Number of power cabinet</td>
<td>4 (20 feet solution)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>400 Vac</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 43/54 (MV SWGR/transformer)</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Charging Power</td>
<td>Up to 8 x 173kW</td>
</tr>
<tr>
<td>Number of power cabinet</td>
<td>2 to 8</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>400-480 V</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 54 LV Switchboard</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

- Improved Safety of type tested equipment that’s easy to install
- Easy to ship, load and offload
- Relocatable solution adapt for temporary power needs
- Maximize ROI with pre engineered and pre tested solution
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**

<table>
<thead>
<tr>
<th>Typical Ratings: Up to 500kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power up to 500kW</td>
</tr>
<tr>
<td>Storage capacity up to 500kWh</td>
</tr>
<tr>
<td>Rated voltage: 400-480 V</td>
</tr>
<tr>
<td>Protection degree: IP 54 LV Switchboard/ IP 23 Transformer</td>
</tr>
<tr>
<td>Applicable standards: IEC, GB, AS, GOST, ANSI, CSA, and more</td>
</tr>
</tbody>
</table>

- **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**