E-mobility Fleet Electrification Solutions

Electrification - Packaging and Solutions
Agenda

- Market size and growth
- Charging infrastructure basics
- ABB e-mobility infrastructure solutions for fleets
  - Bus depot
  - Bus en route charging
  - Industrial fleets
  - Commercial fleets
- 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

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**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
Trend towards bigger cars with higher power requirements

- **Power requirements are increasing**

### DC high-power charging CCS (≥150 kW @800 V)
- 100 kW: Audi e-tron sportback
- 110 kW: Audi e-tron
- 150 kW: Audi e-tron S, Lamborghini Urus
- 200 kW: Audi e-tron GT

### DC fast charging CHAdeMO (50-150 kW @400 V)
- 77 kW: Mitsubishi Outlander PHEV
- 100 kW: Opel Ampera-e
- 110 kW: Nissan Leaf
- 140 kW: Nissan e-NV200
- 150 kW: Tesla Model 3, Smart EQ Forfour
- 300 kW: Tesla Model S, Mercedes-Benz EQS

### DC fast charging CCS (50-150 kW @400 V)
- 110 kW: Volkswagen e-Up!
- 120 kW: VW e-Golf
- 130 kW: BMW i3
- 140 kW: Hyundai Ioniq
- 150 kW: Kia e-NV200
- 200 kW: Tesla Model S, Mercedes-Benz EQB
- 300 kW: Tesla Model X, Nissan Leaf E+
- 400 kW: Hyundai Ioniq 5, BMW iX3
- 500 kW: Kia Kona EV, Mercedes-Benz EQC

### AC fast charging 43 kW
- 110 kW: Nissan Leaf, Citroën C-Zero
- 120 kW: Peugeot Partner, Kia Soul EV
- 130 kW: Tesla Model X, Tesla Model S, Nissan e-NV200, Mitsubishi Outlander PHEV
- 140 kW: BMW i3, Smart ED, Renault Zoe ZE
- 150 kW: Kia e-NV200, Peugeot Onyx, Citroën C-Zero

### AC 22 kW OBC
- 110 kW: Tesla Model S, Ford Focus Electric, Renault Zoe ZE
- 120 kW: Mini Cooper SE, Smart ED

### AC 11 kW OnBoardConverter
- 110 kW: Mercedes-Benz EQS, Tesla Model S, Ford Focus Electric

### Only AC slow (3.6-7.2 kW)
- 110 kW: Smart ED Gen 1, Tesla Model S, Ford Focus Electric

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Increasingly more electric commercial vehicles and truck models coming

**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 11 kW OnBoardConverter**

**Only AC slow (3.6-7.2 kW)**

**DC charging CCS < 50 kW @ 400V**

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Trends toward faster charging times and higher power

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

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

<table>
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<td><strong>AC destination</strong></td>
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<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, restaurant
- High turnover parking
- Convenience fueling stations
- Highway truck stops and travel plazas
- OEM R&D

- 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

- 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

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For car

(*350kW)

For bus
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<th>DC Fast</th>
<th>Depot Charging</th>
<th>DC High Power</th>
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<tr>
<td>Power (kW)</td>
<td>3-22</td>
<td>20-25</td>
<td>50-180</td>
<td>50-150</td>
<td>150-600*</td>
</tr>
<tr>
<td>Time (Hours)</td>
<td>4-16</td>
<td>1-3</td>
<td>20-90</td>
<td>4-8</td>
<td>10-20</td>
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Public and commercial EV Charging

Alternate use-cases for depots

For car (*350kW)

For bus
## E-mobility solutions landscape for cars and fleets

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- **DC destination**
  - Retail, grocery, mall, big box, restaurant
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  - Highway truck stops and travel plazas
  - OEM R&D

- **Depot Charging**
  - 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

- **DC High Power**
  - Highway corridor travel
  - Metro "charge and go"
  - Highway rest stops
  - Truck stops
  - Petrol station areas
  - City ring service stations
  - OEM R&D

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Our focus for this presentation

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

- E-bus chargers
  - HVC
- AC chargers
  - DC fast chargers
  - Terra systems
- Service
  - Asset management
  - Upgrades & retrofits
  - Installation & commissioning
- Energy storage
  - ESM
- Integrated solutions
  - Energy storage
  - eHouse with chargers
- Electrical power
  - Electrical only
- Distribution Solution Components
  - MV & LV Switchgear
  - Relay
- Charging network software services
  - ABB Ability
- Energy Management
  - EV Site Solutions
- Residential
  - Distribution boards/panels
  - Home automation
**Electrical systems supporting chargers get more complex**

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

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<tr>
<td>DC charger</td>
<td>50-150 kW+</td>
<td>150-350 kW+</td>
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<tr>
<td>Electrical Infrastructure</td>
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<td>Circuit protection</td>
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<td>Residual current protections</td>
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<td>Smart meters - optional for facility energy management</td>
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<td>ABB Charger</td>
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**ABB Charger**

- AC charger
- DC charger
- Electrical Infrastructure
  - Cable pillars
  - Circuit protection
  - Residual current protections
  - Energy management solutions
- Energy management solutions
- Switchboards
- 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

Productized solutions

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

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

- Modular solution reduces complexity – 60% faster to deploy
- Factory assembled, pre-wired and pre-tested - reduces risk by over 90%
- Arc tested solution – safe for installation in public areas
- Transportable provides flexibility to move between sites
Productized solution

Integrated charger solution

- Factory assembled, pre-wired and pre-tested - reduces risk by over 90%
- Integrated chargers simplify space constraints, connections and prevent start-up delays
- Transportable - provides flexibility to move between sites
- Arc tested solution – safe for installation in public areas
- Optimized charging through intelligent energy management
- Modular solution reduces complexity – 60% faster to deploy
**Productized solution**

Energy storage

- **Factory assembled, pre-wired and pre-tested** - reduces risk by over 90%
- **Transportable** - provides flexibility to move between sites
- **Modular solution** reduces complexity – 60% faster to deploy
- **Critical power operations digitally controlled** for fastest response time
- **Asset health and management** for product longevity
- **Energy management software** for optimization and energy storage control
Solution architecture

Electrification and digital offering

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

- Pre-engineering reduces project complexity
- Strong digital solutions for improved asset and energy management
- Digital connectivity provides greater flexibility and information
- Application based ABB products for seamless integration

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Customized Solutions
Packaging & eHouses

Custom engineering – unique product engineering requirements to specific specifications

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

Complex projects that require a custom or tailor-fit solution

Project that requires design, engineering, integrated components, manufacturing and project management
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.
Offering by application
Offering by application

Fleets

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

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

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

- **Commercial fleet**
  - Medium 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

<table>
<thead>
<tr>
<th>Voltage rating</th>
<th>Power rating</th>
<th>Applicable standards</th>
<th>Standard components</th>
<th>Key solution features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EcoFlex with HP chargers</strong></td>
<td>Up to 1kV</td>
<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><strong>UniSub with HP chargers</strong></td>
<td>Low voltage connection</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>
</tr>
</tbody>
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### Battery energy storage building blocks

<table>
<thead>
<tr>
<th>System</th>
<th>Voltage rating</th>
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<td>EcoFlex with energy storage</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>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>
</tr>
<tr>
<td>EcoFlex Energy Storage Modules</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>
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## Bus depot

### Electrical infrastructure building blocks

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<th>Multi-module EcoFlex</th>
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<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>
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| EcoFlex              | 2.4 – 40.5kV  | 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  | 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

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

- SafePlus MV Switchgear
- RESIBLOC® Transformer
- Depot-Boxes for smallest footprints
- MNS® LV Switchgear
- HVC power cabinet
- Flexible positioning of Power Units
- Depot charging box
- ABB 150C Heavy Vehicle Charging Systems
- ABB HVC 150-C
- 150 kW Charging Power per Charging System
- 44
- 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*
- >213 Mio.
- 100 %
- 83,000 t
- Lost space

Ladestationen, elektrotechnische Infrastruktur und Netzanschluss werden im bestehenden Raum über den Bussen im Depot installiert.
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
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

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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>
</tr>
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<td>UniSub with HP chargers</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>
</tr>
<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>
</tr>
<tr>
<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>
</tr>
</tbody>
</table>
### eBus en route charging

Battery energy storage building blocks

<table>
<thead>
<tr>
<th>Voltage rating</th>
<th>Power rating</th>
<th>Applicable standards</th>
<th>Standard components</th>
<th>Key solution features</th>
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</thead>
<tbody>
<tr>
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<td><strong>CSS with energy storage</strong></td>
<td>2.4 – 40.5kV</td>
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<td><strong>EcoFlex with energy storage &amp; HP chargers</strong></td>
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<tr>
<td><strong>EcoFlex Energy Storage Module</strong></td>
<td>Up to 1kV</td>
<td>Up to 500kW/500kWh</td>
<td>IEC, ANSI</td>
<td>LV switchboard, energy storage</td>
</tr>
<tr>
<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>
</tr>
</tbody>
</table>
### eBus en route charging

**Electrical infrastructure building blocks**

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<tr>
<td><strong>EcoFlex</strong></td>
<td>2.4 – 40.5kV</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>
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<tr>
<td></td>
<td>Typical rating (kVA): up to 4000 kVA</td>
<td></td>
<td></td>
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<tr>
<td><strong>Compact Secondary Substation (CSS)</strong></td>
<td>2.4 – 40.5kV</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>
<tr>
<td></td>
<td>Typical rating (kVA): up to 3150 kVA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>Voltage rating</th>
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<td>EcoFlex with HP chargers</td>
<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>
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<tr>
<td>CSS with HP chargers</td>
<td>2.4 – 40.5kV</td>
<td>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>EcoFlex w/ energy storage &amp; HP chargers</td>
<td>2.4 – 40.5kV</td>
<td>Up to 400kW/400k Wh</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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<tr>
<td>CSS with HP chargers</td>
<td>2.4 – 40.5kV</td>
<td>Up to 2000 kVA</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>
# Industrial fleet

Battery energy storage building blocks

<table>
<thead>
<tr>
<th>Model</th>
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<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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<td>EcoFlex w/ energy storage &amp; HP chargers</td>
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<tr>
<td>EcoFlex Energy Storage Module</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>
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## 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>
<th>Voltage rating</th>
<th>Applicable standards</th>
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</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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<tr>
<td><strong>EcoFlex w/ LV distribution &amp; HP chargers</strong></td>
<td>Up to 400kW/400kWh</td>
<td>IEC, ANSI</td>
<td>LV distribution, 8 power modules or 4 power modules and 2 charging posts</td>
<td>Quick setup; plug-and-play solution, reduced site works, standard connection interfaces</td>
</tr>
</tbody>
</table>
# Commercial fleet

Battery energy storage building blocks

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<tr>
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## Commercial fleet

### Electrical infrastructure building blocks

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<tr>
<td>up to 3150 kVA</td>
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<td></td>
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</tbody>
</table>
Other considerations
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</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

**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