



# eBus fast charging solutions

ABB Global Product Group Electric Vehicle Charging Infrastructure

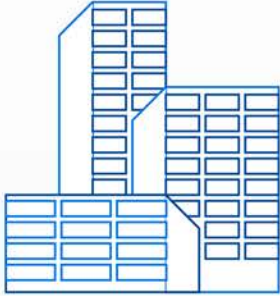
# A global leader in power and automation technologies

## Leading market positions in main businesses

~135,000   
employees

 **\$ 36**  
billion  
In revenue  
(2015)

Present  
in  
**+100**   
countries

Formed  
in  
**1988**   
merger of Swiss (BBC, 1891)  
and Swedish (ASEA, 1883)  
engineering companies

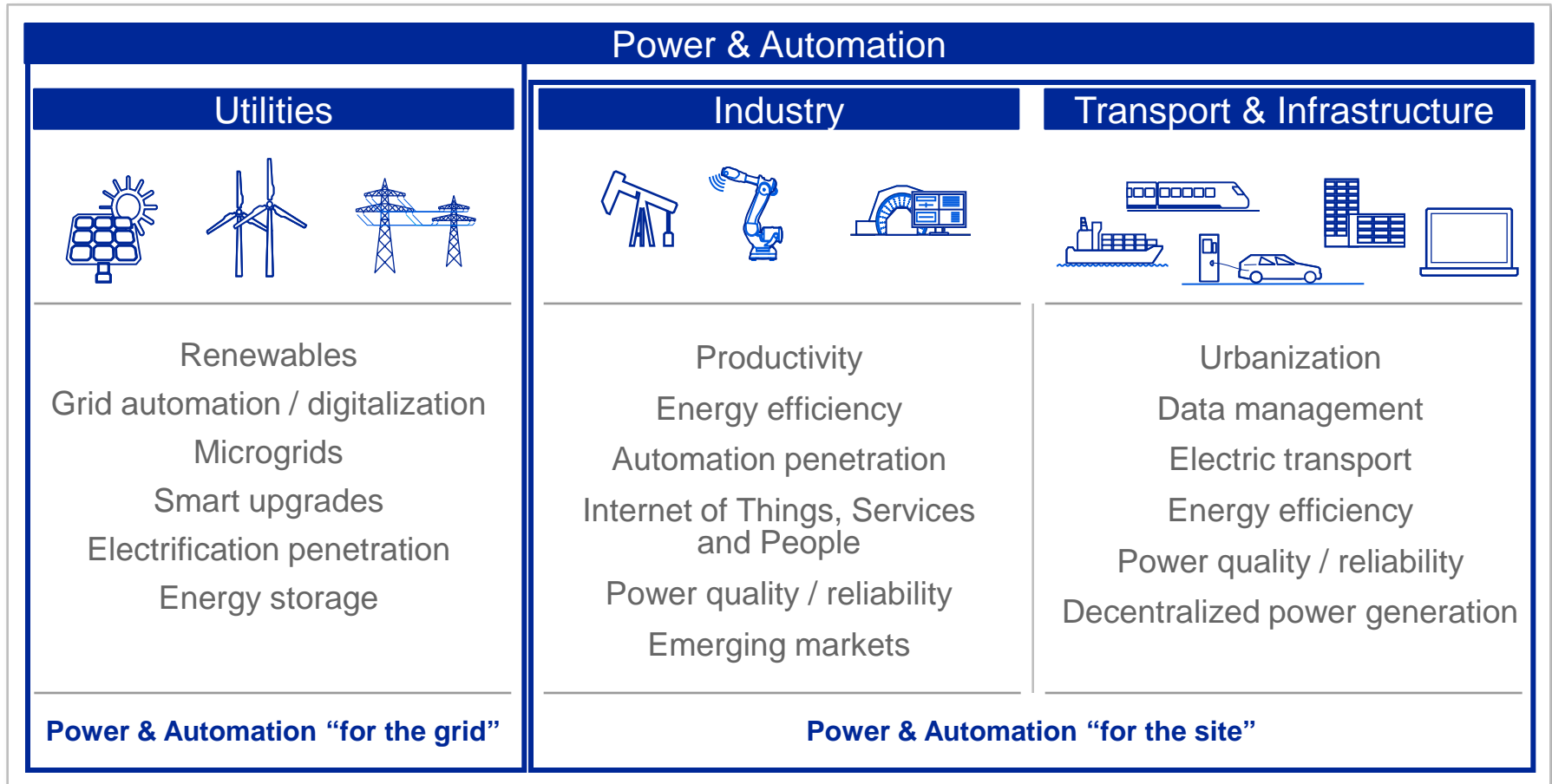
Single "A"  
credit rating

HQ Zurich

**ABB**

# A global leader in power and automation technologies

## Leading market positions in main businesses



# ABB ready for new reality

## Solutions for whole EV charging value chain



### e-bus fast chargers

- HVC series



### Energy storage

- B.E.S.S.



### Drive train solutions

- Motors & converters



### Substations

- Transformers



### DC Fast Chargers

- Terra 53, wallbox

ABB's future-proof solutions will work together seamlessly throughout the whole value chain



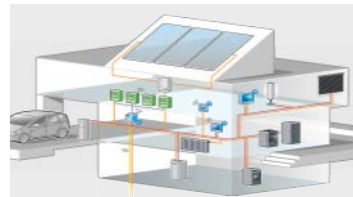
### Grid Automation

- SCADA & Ventyx



### Charging Network Software Services

- Galaxy services



### Building Automation

- KNX, energy mngt.



### Components

- DIN rail & distribution boards



### Renewable Integration

- HVDC, solar, wind



# Global leader in EV fast charging solutions

## Proven technology in the field since 2010

### ABB DC Charging infrastructure

**Active since:** 2010

**Volume:** > 3.000 DC fast chargers installed world wide, biggest installed base of all manufacturers

**Regions:** Europa, Americas, Africa, Asia, China, Pacific

**Standards:** CCS-1, CCS-2, GB/T, CHAdeMO, ISO 15118, IEC-61851-23, SAE J1772

**Connectivity:** Remote management and support, > 99,5% Uptime, global integration with payment systems, RFID, Smartphone, Creditcards and 3<sup>rd</sup> party IT systems.



#### Partner und Referenzen im Bereich DC Schnellladen



und viele mehr...

# ABB is global charging partner for Car OEM's

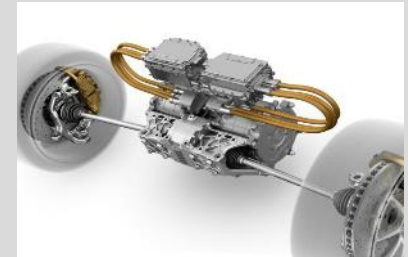
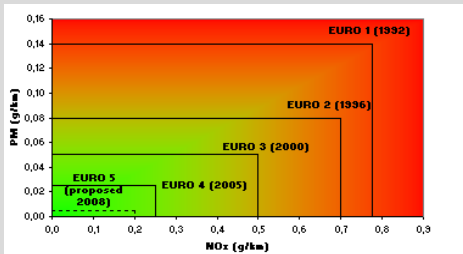
## Strong presence in China, USA and Europe



# ABB enables the transition to eBusses

## Meeting emission norms, reducing air pollution

### Market drivers, challenges & opportunities



**Vehicle manufacturers**  
have to meet strict emission norms

- Sell clean ebusses
- Offer added value
- Contribute to green targets

**Cities**  
are facing air pollution and noise problems

- Reduce air pollution
- Reduce particle emission
- Improve quality & image

**Technology**  
is ready for mainstream market

- Proven electric drive components
- Li-ion battery price declines rapidly

➔ ABB offers technology and system solutions



# Experience and references

## Field tests deployed in the market since 2011

### ABB experience in e-bus projects



#### **Tosa project 2013**

Geneva, CH

En-route charging with  
Automated connection

Intensive passenger  
operation



#### **Offenbach project 2012**

Offenbach, DE

Charging at end-point  
with cable

Passenger operation



#### **Coventry project 2011**

Coventry, UK

Charging at end-point  
with cable

Passenger operation



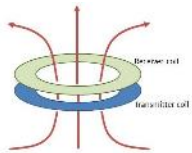
# Comparison of technologies

## Conductive fast charging is practical and cost efficient



### Overnight charging

- Large and heavy battery inside vehicle
- Reduced passenger capacity



### Inductive charging

- Low energy efficiency
- High cost & weight inside vehicle
- High vehicle cost & complexity
- Expensive installation & maintenance



### Overhead wires / trolley

- Higher infrastructure cost
- Higher maintenance cost
- Visual quality problems in cities



### Hydrogen

- High cost busses
- High cost infrastructure
- Safety considerations



### Conductive fast charging

- Low cost & weight components inside vehicle
- Low vehicle cost & complexity
- Efficient energy transfer
- Robust & proven technology

# Market is ramping up: commercial roll out in 2016/2017

## Example project: Luxembourg MDDI



### Luxembourg 2016

- MDDI
- 1 pilot line operated by Sales-Lentz
- Volvo Electric Hybrid
- 2 x 150kW ACS – 2016
- 2 x 300kW ACS – 2017
- Intensive passenger operation
- Operational 2016



LE GOUVERNEMENT  
DU GRAND-DUCHÉ DE LUXEMBOURG  
Ministère du Développement durable  
et des Infrastructures

Département de l'environnement



# Market is ramping up: commercial roll out in 2016/2017

## Example project: TEC Namur



### TEC Namur, Belgium

- SRWT/TEC
- 11 x Volvo Electric Hybrid
- 2 x ABB 150kW ACS
- Transformers and Substations
- Intensive passenger operation
- Operational 2016



# Market is ramping up: commercial roll out in 2016/2017

## Example project: Ville de Luxembourg



### Ville de Luxembourg, Luxembourg

- Operator: Ville de Luxembourg
  - 2 lines
  - 5 x Volvo Electric Hybrid
- 4 x ABB 150kW ACS (prepared for future growth)
- Transformers and Substations
- Intensive passenger operation
- Operational Q4 2016 / Q1 2017





# Fast eBus charging allows 24-7 operation

## Typical solution: eBus charges 4-6 minutes at route end points

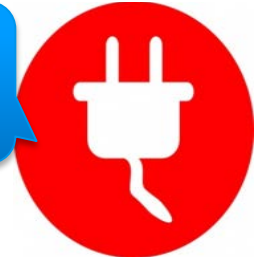
Lines  
<1 hour  
(<20km)



Battery in bus  
20..100 kWh  
(~15-80km)



Charge power  
150-300 kW  
4-6 min.



< 20 km

### End point 1

- 300 kW
- Automated connection
- 4-6 min. charging



### End point 2

- 300 kW
- Automated connection
- 4-6 min. charging

# A practical fast charging solution for e-busses

## Charging at route end-points, how does it work?



Bus arrives  
at stop

- Wifi communication charger & bus
- Driver indicates readiness

Charging  
procedure  
starts

- Pantograph comes down
- PE & safety check (continuous)
- Start of power flow

Charging  
procedure  
ends

- Busdriver sees charge progress
- Busdriver indicates readiness
- Pantograph goes up

Bus drives  
away

- Sensors check if pantograph is up
- Busdriver receives signal
- Busdriver drives away

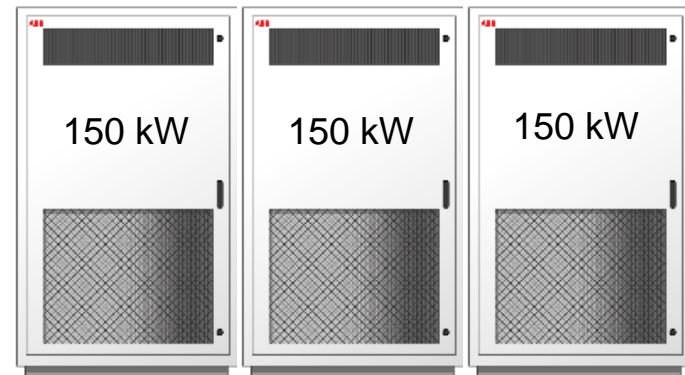
# A practical fast charging solution for e-busses

## Reliable, scalable, based on industry standards



- Automated connection system
- High power DC transfer to bus
- Wireless communication to bus
- Based on
  - EN/IEC 61851-23
  - ISO/IEC 15118

- Industrial quality power cabinet
- 150kW, 300kW & 450 kW modular
- Redundancy per each 150kW module
- 400-850 V<sub>DC</sub>
- Galvanic isolation
- Remote management



**ABB**

# Open industry standards are key to success

## Industry is working on global & EU standardization

### Standardization

#### Goals

- Safety
- Automotive quality
  - Interoperability
- Prevent technology lock-in
  - Reduce cost
- Attractive for end customer

#### Passenger cars (2011)

CCS-2 connector



#### Electric buses (2015-2016)

Depot charging (CCS-2 connector)



and

Automated Connection System with pantograph

Supported by:

EU



- EN/IEC 61851-23
- ISO/IEC 15118
- DIN70121



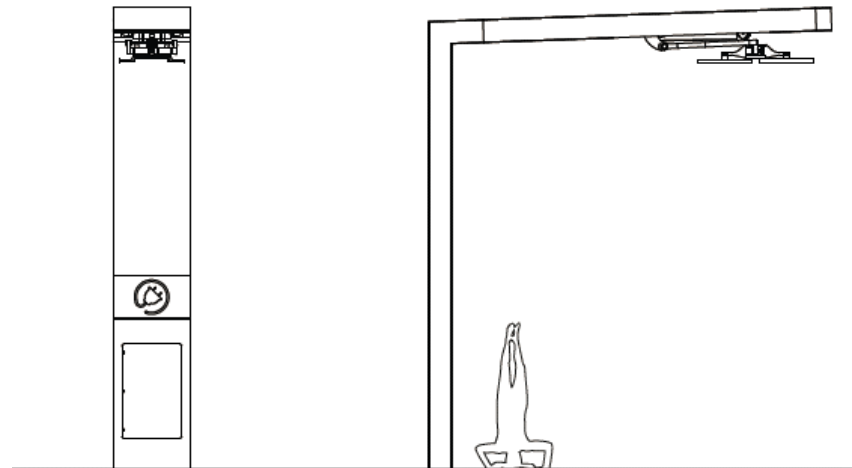


# Charge mast with pantograph

## Standard ABB mast design



Mast Height ~5.3 m  
Mast Outreach ~4.6 m  
Mast Width ~0.9 x 0.3 m



# Product portfolio

## ABB offers complete solutions for eBus charging

High power platform

Depot charging CCS-2  
50 – 150kW



Opportunity charging  
150 -450kW



Separate MV  
transformer station



Connectivity

Globally compliant  
server architecture



IT system integration

API platform  
> 50 successful  
integrations

Web modules &  
statistics



Service

ABB global NOC  
support



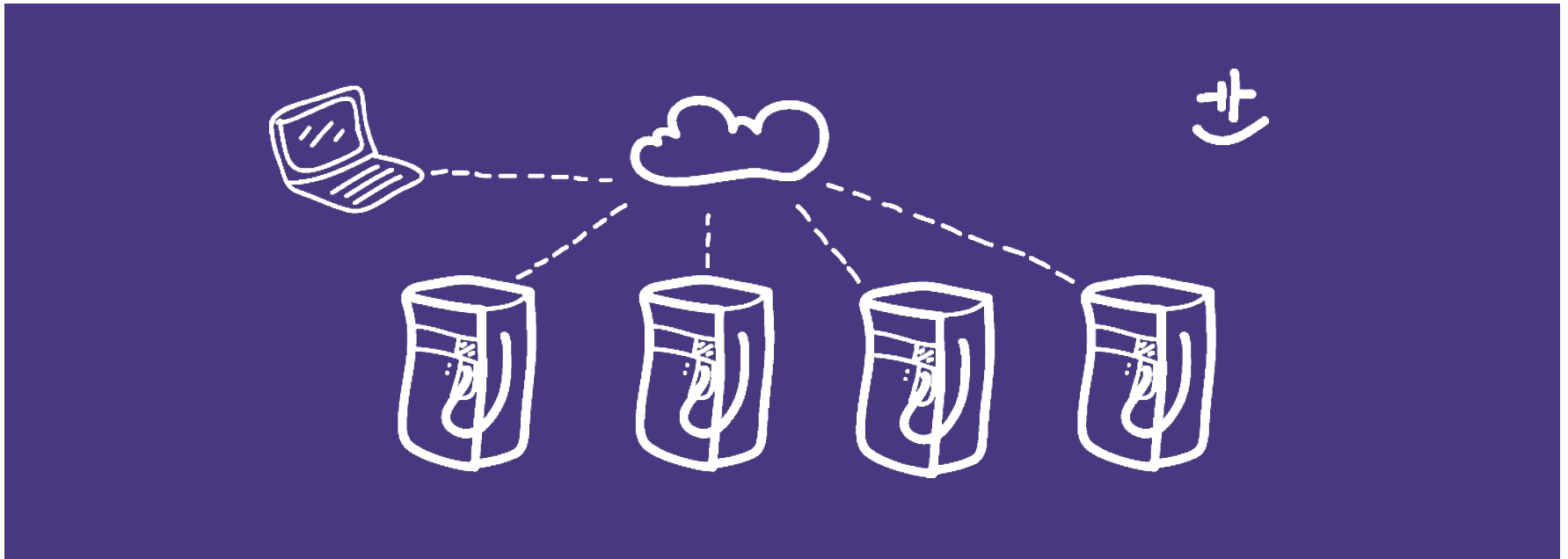
> 250 trained local ABB  
experts



3<sup>rd</sup> party training for  
partners



# Installation of eBus charger



# Example of installation process

## Volvo Gothenborg





# Example of installation proces

## Volvo Gothenborg



# Example of installation proces

## Volvo Gothenborg





# Example of installation proces

## Volvo Gothenborg



# Example of installation proces

## Volvo Gothenborg





# Example of installation proces

## Volvo Gothenborg



# Example of installation proces

## Volvo Gothenborg



### **Support from ABB:**

- Full installation manual of charger
- Experienced project managers
- Good understanding of local grid (low and medium voltage)
  - Pre fab foundations
- Dedicated support & Support, both local and global



# Mobile charger

## For demonstrations and Proof of Concept



# Mobile charger

## For demonstrations and Proof of Concept





# Mobile charger

## For demonstrations and Proof of Concept



Power and productivity  
for a better world™

