Proud to present @ Vector E-Mobility Engineering Day
April 16th, 2019

chargeBIG
powered by MAHLE

The missing link for Electric Vehicles
Who is MAHLE?

- 78,000 employees
- 170 production locations in 32 countries on five continents
- 12.8 billion EUR sales (2017)
- 16 R&D centers with around 6,100 engineers and technicians in Germany, Great Britain, Luxembourg, Slovenia, Spain, the USA, Brazil, Japan, China and India
The Dual Strategy of MAHLE

- Highly Efficient Combustion Engines
- Emerging Markets
- Commercial Vehicles & Off-Highway
- Aftermarket
- HVAC
- Thermal Management
- Electric Drive Systems
- Electric Auxiliaries
- Power Electronics
- Integrated Powertrain
- New Projects

Strengthen our existing market position
Shape the future in a changing mobility world
The Team of Corporate Startup chargeBIG...

...enables e-mobility by providing large scale affordable charging infrastructure
Contents

• Hypotheses
• Market
• Technology
• Status & Roadmap
Hypotheses
Hypotheses

• Energy is not the issue, just peak power!

• E-mobility will explode. As will the infrastructure!

• We need a „Trinity“ of charging infrastructure to solve the „hen & egg“ issue
Energy is not the issue, just peak power!
Energy is not the issue, just peak power!

- **Excess energy** exported out of Germany 2017 = 54 TWh
  - **Enough** to charge 19 Mio electric vehicles
- Average power necessary to charge a car = 1 kW*
  - Average power is not the **issue, just peak power**
- **chargeBIG manages peak power!**

* assumption: 2,800 kWh annual vehicle energy consumption, 10 h/day, 250 days/a
E-mobility will explode.
As will the infrastructure!
E-mobility will explode. As will the infrastructure!

... numbers are still small
... but growth is big
... for years

... very big figures forecasted here
... is the huge grid capex really necessary?

Source: Goldman Sachs Global Investment Research.
We need a “Trinity” of charging infrastructure
Old school

**Single AC charging points (wallbox)**
- Dumb
- Fast (3.7 – 22 kW)
- Too expensive to scale
- Charging@home for short distance
- Household electric supply
- High load on electric infrastructure
- Security problem in public space

**Fast DC charging**
- Intelligent
- Very fast (50 – 350 kW)
- Very expensive
- Charging@highway for long distance
- Powerful electric supply
- High load on power grid

AC = alternating current
DC = direct current
Our new solution

Large scale AC destination charging
- Intelligent
- Fast enough (2.3 – 7.2 kW)
- Very affordable
- Charging@parking for daily distance
- No investment in new transformer
- Positive for electric grid
- IT Security given

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## Competitive edge

<table>
<thead>
<tr>
<th>Customer benefit</th>
<th>Single AC</th>
<th>MAHLE chargeBIG</th>
<th>Fast DC</th>
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<tbody>
<tr>
<td>Price</td>
<td>€€</td>
<td>€</td>
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<tr>
<td>Maintenance</td>
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<tr>
<td>Usability</td>
<td>+</td>
<td>++</td>
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<tr>
<td>Load Management</td>
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<td>+++</td>
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<tr>
<td>Power</td>
<td>++</td>
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“Design to cost in focus, design thinking in mind”

- Centralized intelligent charging infrastructure
- Dynamical phase individual load management / load shedding
- No new transformer necessary
- Very low running expenses
- Low damages in case of vandalism
- Essentially smaller investment than today’s competitive solutions
- Reduced to the max
- Economy of scale
»Der Testbetrieb lief ohne Probleme! Nun kann die Anlage in Betrieb gehen.«
Airport STR, 15/03/2019

#18 charging points for fleet and employee parking.

further #92 charging points in 2019. Installation of next 33 charging points starts in cw22.
BMWi public funding project @ MAHLE car park

Start of installation of Demonstrator100
» March 2019

Finish of Demonstrator100
» June 2019

Grand opening of Demonstrator100
» July 2019
**Upgraded electronics and payment system**

- **Payment and access** control via App / QR code / terminal

- **Eichrecht**

- ISO15118 plug & charge

- Integration of **battery storage** and photovoltaic

- Upgrade functions of load management software

- Development of production design for **US and China**
Use cases

Equipping of parking facilities with charging infrastructure for

airport & fairs  employer car parks  fleet operators
Hypotheses –
Follow up
Hypotheses

- Energy is not the issue, just peak power! ✓

- E-mobility will explode. As will the infrastructure! ✓

- We need a „Trinity“ of charging infrastructure to solve the „hen & egg“ issue ✓
we enable E-Mobility
with a plug @ each and every parking spot!