Electric Mobility as a green Transformation Anchor

Christoph Lienemann
Bastian Manz

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Electric Mobility as a green Transformation Anchor

1. Introduction PEM Motion
2. Changes in mobility & automotive industry
3. Focus on the Caribbean
4. Summary
Electric Mobility as a green Transformation Anchor

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We create innovation – and industrialize it!

**PEM MOTION**

**Engineering and Consulting Services**

+ >100 employees with 60% engineers
+ 8.8 m€ revenue PEM Motion Group in 2019
+ > 150 PEM Motion customers with 2/3 established companies and 1/3 young start-ups

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**PEM X**

**Spin-Offs and JVs in the field of future urban logistics**

+ 7 investments with >100 m€ company value
+ >180 employees within the PEM X network
+ Successful exits: StreetScooter (> 640 employees at exit), e.GO (> 450 employees at exit), StreetScooter Research (> 50 employees at exit)
Locations in 8 cities in Germany and North America

- Aachen
- Stuttgart
- Köln
- Frankfurt
- Berlin
- Sacramento, California
- Monterrey, Mexico
- San Luis Potosi, Mexico
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Megatrends of Future Mobility

- E-Mobility
- Autonomous Driving
- Connectivity
- Shared Mobility
Today's focus

Megatrends of Future Mobility

E-Mobility

Autonomous Driving

Connectivity

Shared Mobility
Megatrend E-Mobility – Forecast of the production

Share of e-vehicles in total vehicle production worldwide

- 50%
- 40%
- 30%
- 20%
- 10%

2020

- 10%: BCG 2017, Europe PHEV: 3%, BEV: 1%
- 11%: USA PHEV: 4%, BEV: 1%
- 17%: China PHEV: 4%, BEV: 2%

2025

- 29%: Schaeffler '17
- 28-42%: European Commission '16
- 20-30%: European Commission '16

2030

- 50%: Schaeffler '17
- 33%: BCG '17
- 30%: Bloomberg '16
- 29%: Schaeffler '17
- 23%: Roland Berger '16
- 15%: Schaeffler '17
- 16%: BCG '17


Various influencing factors

- Legal regulations, e.g. diesel bans
- Development of raw material availability, e.g. cobalt or manganese
- Number and availability of (charging) infrastructure
- Change in user behavior, e.g. shared mobility
- Application of state or local subsidies
- Greenwashing
- Price development (economies of scale)
- …
E-Mobility leads to big changes in automotive sector

Due to electric mobility a large number of mechanical components are displaced from the drive train...

**Cost structure of a conventional vehicle**

- **Miscellaneous**: 15-20%
- **Chassis**: 9-12%
- **Body**: 11-20%
- **Power Train**: 22-24%
- **Equipment**: 30-37%

**Power Train**
- **Power Train basis**: 35-40%
- **Auxiliary units**: 18-22%
- **Gears**: 20-27%
- **Exhaust system**: 8-11%

**Complete Vehicle**
- **Miscellaneous**: 7-9%

**Components**
- Generator
- Intake manifold
- Camshaft
- Connecting rod
- Piston
- Fuel tank
- Oil and water pumps
- Engine block
- Cooling system
- Engine electronics
- Crankshaft
- Belt drive
- Injection system
- Intake manifold
- Oil and water pumps
- Oil and water pumps
- Fuel tank
- Coupling
- Piston
- Coolant
- Oil and water pumps
- Side shafts incl. synchronism
- Jacket
- Rear silencer incl. tail pipe
- Catalyst
- Differential
- Exhaust manifold
- Intake manifold
- Intake manifold
- Connecting rod
- Connecting rod
- Piston
- Piston
E-Mobility leads to big changes in automotive sector

...and in addition a multitude of electronic components are used in the powertrain.

### Cost structure of an electric vehicle

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous</td>
<td>6-15%</td>
</tr>
<tr>
<td>Chassis</td>
<td>5-9%</td>
</tr>
<tr>
<td>Body</td>
<td>8-19%</td>
</tr>
<tr>
<td>Power Train</td>
<td>10-20%</td>
</tr>
<tr>
<td>Equipment</td>
<td>13-27%</td>
</tr>
<tr>
<td>Battery</td>
<td>40-50%</td>
</tr>
<tr>
<td>Complete Vehicle</td>
<td></td>
</tr>
<tr>
<td>Power Train</td>
<td></td>
</tr>
</tbody>
</table>

#### Comparison: Number of parts required

<table>
<thead>
<tr>
<th>Component</th>
<th>Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion engine</td>
<td>~2500</td>
</tr>
<tr>
<td>Electric engine</td>
<td>~250</td>
</tr>
</tbody>
</table>

Source: [https://e-auto-journal.de/elektromotor-vs-verbrennungsmotor/](https://e-auto-journal.de/elektromotor-vs-verbrennungsmotor/)
Our vision

Cut the total cost of last mile logistics by 50%
Aachen Ecosystem for Hardware Innovation
Solutions to cut costs in last mile logistics

1st base camp in Bochum to create central logistic hubs in cities

Automated vehicle scanner to reduce damages and insurance costs

H2 infrastructure and modular fuel cell range extender (in development)

Multi storage delivery stations with blockchain secured locking (in development)

Digital out of home advertisement with modular screens

B2B mobility solutions from bike sharing to individual car sharing apps

New last mile trailers with automated follow me function

Individual solutions for specific use cases can be engineered quickly with a broad technology base
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The Caribbean share several conditions...

+ High **renewable energy potential** throughout the Caribbean
+ **Short distances** due to limited space (especially on smaller islands)
+ Favorable **legal conditions**
  + Specific renewable energy and transportation targets
  + Reduction or elimination of import duties and taxes
+ High utilization of **government and commercial fleets**
+ Especially vulnerable to the consequences of **climate change**

Access to renewable energies as well as political incentives can accelerate the transition to sustainable mobility in the Caribbean

Source: “Electrified Islands”, Viscidi et al., 2020
... but are also faced with challenges

- High consumption of and dependency on **fossil fuels (e.g. power generation)**
- Concerns about declining government revenues over missing taxes
- Lack of comprehensive **charging infrastructure**
- Market not mature enough yet to serve all requested conditions
- Lack of **trained personnel**
- Missing **public awareness**
  - Credibility doubts do exist and there is still convincement necessary that EVs will sell

The Caribbean are still strongly dependent on fossil and lack of general education about electric mobility

Source: "Electrified Islands", Viscidi et al., 2020
Potential actions facilitating the transition to E-Mobility

+ **Governments** should
  1. educate themselves and really analyze **long-term fiscal effects** that the large scale-up of EVs would imply
  2. do **commit** themselves to **E-Mobility** and communicate this clearly to manufacturers, dealers as well as utility companies
  3. seize opportunities to **electrify public transportation**, government as well as commercial fleets

+ More **education** should be provided, and the levels of **public awareness** increased
+ **Utility companies** need to recognize the **potential for growth**
+ **Supporting innovation** and **start-ups locally**

The dialogue and establishment of electric mobility must happen **across sectors** and is ideally initiated by legal actions and political incentives

Source: *Electrified Islands*, Viscidi et al., 2020
How do we create a sustainable ecosystem?

The path to a greener living environment

Image source: Pioneer Park Hanau
Three central pillars for a quick start in the Caribbean

1. Mobility
   1. Electric Vehicles
   2. Infrastructure
   3. Traffic Relief

2. Energy
   1. Energy Production
   2. Energy Storage

3. Local Production
Mobility

1. Electric Vehicles
2. Infrastructure
3. Traffic Relief

Energy
1. Energy Production
2. Energy Storage

Local Production
Mobility solutions are selected due to their local benefit

Electric Vehicles

Assessment of urban characteristics

Identification of urban mobility needs with respect to local public transport and other relevant points of interest

Infrastructure

Sustainable Modular Mobility Stations including

- Packing Station
- Battery Compartments
- Photovoltaics to power the station and batteries

Traffic Relief

What causes traffic at the moment?

What is the future of urban mobility? Create new

Definition of the suiting mobility mix

Selection of mobility solutions depending on identified urban characteristics

- E-Scooter | L1e-B
- E-Bike Passenger | L1e-A
- Cargo EV | StreetScooter
Energy – Energy storage

1. Mobility
   1. Electric Vehicles
   2. Infrastructure
   3. Traffic Relief

2. Energy
   1. Energy Production
   2. Energy Storage

3. Local Production

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Energy Production and Storage

**Energy Production**

Assessing and using of existing technologies correctly

- Identifying potential technologies best suited for predominant conditions
- Technologies for wind and solar energy are already well developed but not used to their full potential
- Challenge: limited possibilities to store energy

**Energy Storage**

Using existing resources instead of new ones

- Old batteries (i.e. from vehicles) can be reused for a second life purpose
- After collection, battery packs are assembled to stationary storage systems to provide various services
- Start of second life as an energy storage unit

**Creating new storage mediums**

- New storage mediums favor a sustainable mobility
- Combination battery and fuel cell
  - Long range and payload similar to conventional combustion engine
  - Short refueling times, high dynamics, TCO-compatible costs
Local Production

1. Mobility
2. Energy
3. Local Production

- Local Production
- Urban Farming
- Species Diversity
- EcoCity
- Living Environment
- Mixture of Uses
- Participation
- Infrastructure
- Electric Vehicles
- Mobility
- Regional Products
- Energy Management
- Energy Storage
- Energy Production
- Local Resources
- Circular Economy

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Local production by establishing the Ramp-up factory

Our Solution
Targets:
+ Reduction of emissions
+ Securement of local supply chains and innovation
+ Creation of jobs and prosperity
→ Introduction and establishment of Ramp-Up Factories

Concept
+ From ideation to production in one facility
+ Addressing start-ups, SMEs, OEMs and research institutions alike
+ Flexible prototyping and manufacturing infrastructure
+ Cost effective industrialization and accelerated time to market
+ In cooperation with leading partners we provide state-of-the-art knowledge

Ramp-Up Factory
Product development phases covered by the ramp-up factory

Specifications & Concept Phase
Engineering
Prototyping & Testing
Industrialization
Production Scale-Up

Idea Phase
PEMs initiatives in the Caribbean and Central America

**México**
- Electrification of cargo vehicles
- Ramp-up Factory Monterrey
- Sustainability Dialogue German Embassy
- Education and university courses
- Training center
- Innovation projects
- Mobility Focus

**Costa Rica**
- Ramp-up Factory
- E-Cargo Hub
- Remanufacturing of Batteries
- Business Development for shared mobility

**Dominican Republic**
- Establishment of local EV production
- Sustainable urban Infrastructure
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Central America and the Caribbean as a pioneer and new value chain partner for sustainable development

- Mixed fleets and unique mobility processes require own solutions
- Strong partner & Universities leading in innovation and training
- Right momentum for creating own solutions for a sustainable mobility locally
- Government & international partners create a great support for sustainable development
- Pollution and traffic are pushing sustainable and smarter solutions

Let’s start working on realizing the future of mobility in the Caribbean already today!
Join us and let’s fuel the future together – now!

Christoph Lienemann  
PEM Motion  
Managing Director North America  
Mail: c.lienemann@pem-motion.com

Bastian Manz  
PEM Motion  
Strategy Consultant  
Mail: b.manz@pem-motion.com

Thank you for your attention!