Schaeffler AG
dbAccess AutoTech Day

22nd June 2018; Winchester House, London
M. Zink & Dr. J. Schröder
CEO Automotive OEM Schaeffler AG | President Business Division E-Mobility
Schaeffler at a glance

Today's speakers – Matthias Zink & Dr. Jochen Schröder

Matthias Zink (49)
CEO Automotive

Dr. Jochen Schröder (47)
President Business Division E-Mobility
New business division E-Mobility

- 64%\(^1\)
- 13%\(^1\)
- 23%\(^1\)

Automotive OEM
- Engine systems
- Transmission systems
- Chassis systems

Automotive Aftermarket
- Europe
- Americas
- Greater China
- Asia/Pacific

Industrial
- Europe
- Americas
- Greater China
- Asia/Pacific

Key aspects
- Automotive OEM with new business division E-Mobility
- Global approach with three regional E-Mobility centers of competence
- Dr. Schröder assumed leadership of the new business division on April 1\(^{st}\), 2018
- Automotive Aftermarket with separate reporting structure

1) in % of Group Sales 2017

Three regional E-Mobility competence centers
- Bühl, Germany
- Wooster, USA
- Anting, China

Accelerate the transformation
Continuous sales growth in Automotive OEM (in EUR bn)

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (EUR bn)</td>
<td>6.7</td>
<td>7.5</td>
<td>8.3</td>
<td>8.5</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Number of patent registrations in Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registrations</td>
<td>2,100</td>
<td>2,518</td>
<td>2,334</td>
<td>2,316</td>
<td>2,383</td>
</tr>
</tbody>
</table>

Sales by division and region in 2017 (in %)

- Transmission: 46.8%
- E-Mobility: 17.6%
- Chassis: 4.6%
- Engine: 31.0%

EUROPE: Incl. Germany, Western, Southern and Eastern Europe, Middle East, Africa, Russia and India

Selected Quality Awards 2017

- Changan Automobile Co. Ltd.: Supplier of the year 2017
- Toyota Motor Europe: Achievement Award
- GAC Honda Auto. Corp.: Outstanding Quality – "Zero Flaw"
- Ford Motor Company "World Excellence Award"
- Fiat Chrysler Automobiles "Outstanding Quality" Award
- Great Wall Motors: Sincere Partnership Award
- Mazda Motor Corp.: Trade Performance Excellence Award
- Jatco Supplier Award-Quality 2017
Overview Automotive OEM

Division Automotive – Broad product portfolio along the entire powertrain and chassis
Overview Automotive OEM

Holistic system understanding on powertrain and vehicle level

- Torsional vibrations
- Virtual testing (Driving dynamics & comfort)
- Fleet simulation
- Thermal management
- Fuel efficiency
- NVH & acoustics
Unique selling points

- Strong mechanical background with a high degree of vertical integration
- Operational and manufacturing excellence with a global production footprint
- Global R&D network and exceptional innovative spirit
- System expertise with outstanding powertrain and simulation competencies

Sustainable & profitable growth through innovation
Powertrain scenario – The market is moving towards the Accelerated scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>ICE</th>
<th>HEV</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>95%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>2020 e</td>
<td>95</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>2025 e</td>
<td>95</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>2030 e</td>
<td>95</td>
<td>11%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: IHS and Schaeffler Assumptions / Values based on Light Vehicles < 6 tons only, ICE = Internal Combustion Engine; HEV = Hybrid Electric Vehicles ranging from 48V Mild Hybrid to PHEV, BEV = Battery Electric Vehicles (incl. Fuel Cell Electric Vehicles)
Strategy “Mobility for tomorrow”

Powertrain scenario – Well to Wheel aspects can't be ignored

New eco-systems require holistic competences across the entire energy chain from energy generation to energy consumption

Source: IHS and Schaeffler Assumptions / Values based on Light Vehicles < 6 tons only; ICE = Internal Combustion Engine; HEV = Hybrid Electric Vehicles ranging from 48V Mild Hybrid to PHEV, BEV = Battery Electric Vehicles (incl. Fuel Cell Electric Vehicles)

Accelerated Scenario
Global vehicle production [in mn units]

<table>
<thead>
<tr>
<th>Year</th>
<th>ICE</th>
<th>HEV</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>95%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>2020 e</td>
<td>86%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>2025 e</td>
<td>55%</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>2030 e</td>
<td>30%</td>
<td>40%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Well to Wheel

2017

95

2020 e

102

110

117

2025 e

2030 e

Source: IHS and Schaeffler Assumptions / Values based on Light Vehicles < 6 tons only; ICE = Internal Combustion Engine; HEV = Hybrid Electric Vehicles ranging from 48V Mild Hybrid to PHEV, BEV = Battery Electric Vehicles (incl. Fuel Cell Electric Vehicles)
Strategy “Mobility for tomorrow”
Powertrain scenario – Regional developments will differ greatly

**Accelerated Scenario**
Global vehicle production [in mn units]

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2020 e</th>
<th>2025 e</th>
<th>2030 e</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE</td>
<td>95%</td>
<td>86%</td>
<td>55%</td>
<td>30%</td>
</tr>
<tr>
<td>HEV</td>
<td>4%</td>
<td>11%</td>
<td>12%</td>
<td>30%</td>
</tr>
<tr>
<td>EV</td>
<td>11%</td>
<td>33%</td>
<td>40%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Source: IHS and Schaeffler Assumptions / Values based on Light Vehicles < 6 tons only; ICE = Internal Combustion Engine; HEV = Hybrid Electric Vehicles ranging from 48V Mild Hybrid to PHEV, BEV = Battery Electric Vehicles (incl. Fuel Cell Electric Vehicles)

**Regional Accelerated Scenario in 2030**
Global vehicle production [in mn units]

<table>
<thead>
<tr>
<th>Region</th>
<th>2030 e</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMEA</td>
<td>28</td>
</tr>
<tr>
<td>North America</td>
<td>18</td>
</tr>
<tr>
<td>South America</td>
<td>5</td>
</tr>
<tr>
<td>Greater China</td>
<td>37</td>
</tr>
<tr>
<td>India</td>
<td>10</td>
</tr>
<tr>
<td>Korea</td>
<td>4</td>
</tr>
<tr>
<td>Japan</td>
<td>9</td>
</tr>
<tr>
<td>SEA</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>2030 e</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE</td>
<td>28</td>
</tr>
<tr>
<td>HEV</td>
<td>18</td>
</tr>
<tr>
<td>EV</td>
<td>5</td>
</tr>
<tr>
<td>ICE</td>
<td>19%</td>
</tr>
<tr>
<td>HEV</td>
<td>38%</td>
</tr>
<tr>
<td>EV</td>
<td>45%</td>
</tr>
<tr>
<td>ICE</td>
<td>1%</td>
</tr>
<tr>
<td>HEV</td>
<td>1%</td>
</tr>
<tr>
<td>EV</td>
<td>98%</td>
</tr>
<tr>
<td>ICE</td>
<td>21%</td>
</tr>
<tr>
<td>HEV</td>
<td>24%</td>
</tr>
<tr>
<td>EV</td>
<td>55%</td>
</tr>
<tr>
<td>ICE</td>
<td>52%</td>
</tr>
<tr>
<td>HEV</td>
<td>25%</td>
</tr>
<tr>
<td>EV</td>
<td>17%</td>
</tr>
<tr>
<td>ICE</td>
<td>6%</td>
</tr>
<tr>
<td>HEV</td>
<td>15%</td>
</tr>
<tr>
<td>EV</td>
<td>89%</td>
</tr>
</tbody>
</table>

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Balancing the scale – No regulatory impact

CO2 Emissions EU 2017\(^1\)

- New cars sold emitted on average 118.5 g CO\(_2\)/km (+0.4 g/km compared to 2016)
- The average fuel efficiency of petrol cars has been constant in the last two years
- Due to growing SUV mix and higher weight of the cars, the fuel-efficiency of diesel cars has worsened in 2017 (+1,1 g/km versus 2016)

Key findings 2017\(^1\):

- New cars sold emitted on average 118.5 g CO\(_2\)/km (+0.4 g/km compared to 2016)
- The average fuel efficiency of petrol cars has been constant in the last two years
- Due to growing SUV mix and higher weight of the cars, the fuel-efficiency of diesel cars has worsened in 2017 (+1,1 g/km versus 2016)

\(^1\) Data Source: EAA (European Environment Agency): "Monitoring of CO2 emissions from passenger cars - Data 2017 - Provisional data"
Strategy “Mobility for tomorrow”

Powertrain scenario – Regulations in 2021 will accelerate the market change

Balancing the scale – Fines will impact OEM offering

CO2 Emissions EU 2021

Key assumptions 2021:

► The average fuel efficiency of petrol & diesel cars improve but move above target, share of diesel vehicles likely to decline further

► 48 V Hybridization mainly driven by P0 systems ("quick win" solutions)

► Hybrid technology as major steering element to achieve emission targets

2) Qualitative presentation only
Balancing the scale – ICE optimization at its limit

CO2 Emissions EU 2025

Key assumptions 2025:

1. Fuel efficiency of petrol & diesel cars remains above target – overall volumes to decrease due to PHEV/BEV uptake
2. 48 V as the new standard: With increasing shares of higher degrees of hybridization (P2 systems), efficiency of this segment improves significantly
3. Push of OEM’s towards BEV to achieve CO2 target

Electrification accelerates
PHEV/BEV become key lever

2) Qualitative presentation only

*Target 2025 currently in discussion
Strategy “Mobility for tomorrow”

Automotive OEM– Product portfolio adjusting to market demand

ICE Product Portfolio

HEV/BEV Product Portfolio

Mechanical and system knowhow remains key
**Powertrain Matrix – Strong Position across all Powertrains**

<table>
<thead>
<tr>
<th>Micro HEV</th>
<th>Mild HEV</th>
<th>PHEV</th>
<th>xEV</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="E-Mobility" /></td>
<td><img src="image2.png" alt="Engine" /></td>
<td><img src="image3.png" alt="Transmission" /></td>
<td><img src="image4.png" alt="Other" /></td>
</tr>
</tbody>
</table>

**Schaeffler AG | dbAccess AutoTech Day**
E-Mobility – Our key growth accelerator

**HEV/PHEV: P2 Hybrid modules (and hybrid transmissions)**

- **Hybrid Module Gen. 2**
  - SOP 2017

- **Hybrid Module Gen. 3**
  - with integrated start-up element
  - SOP 2019

- **Hybrid Module Gen. 4**
  - HV/48 V with integrated e-Drive
  - SOP 2020
  - SOP 2022

**HEV/PHEV/xEV: E-Axle drives**

- **Mech. Axle**
  - 2-speed, PHEV
  - SOP 2017

- **Mech. Axle**
  - 1-speed, EV
  - SOP 2018
  - SOP 2019

- **E-Axle systems incl. EM & PEU (and optional torque vectoring)**
  - (HV 1-speed or 48 V 2-speed/3-in-1/integrated e-Drive)
  - SOP 2021+
  - Booked
  - Target
Product Portfolio Automotive OEM

E-Mobility – More than 30 customer projects and 8 series contracts

Today

More than 30 customer projects and 8 series contracts of which 2 Hybrid Modules and 6 E-Axles.
Key aspects

► Strong mechanical background transfers to E-Mobility: First E-Axle Transmissions in SOP in 03/2018.

► Successfully established development and integration capabilities for E-Machines & Power Electronics.

► Bundled software and integration expertise from existing products in the business division E-Mobility (e.g. actuators & DCT)

Mechanical knowhow is key in system integration.
**Schaeffler E-Mobility – Electric Machines Development & Production**

**Product Portfolio Automotive OEM**

- **Rotor Manufacturing Processes**
  - **Stamping**
    - Key expertise of Schaeffler
  - **Packetizing**
    - Today BUY, option for MAKE
  - **Slot Insulating**
    - Prototyping Compact Dynamics & IDAM
  - **Copper Wire Forming**
    - Ex. E-VCT, IDAM, ...
  - **Slot Closure**
    - Prototyping Compact Dynamics & IDAM
  - **Mech. Fixing & Therm. Conduction**
    - Ex. Filament-wound industr. components
  - **Contacting**
    - Ex. Actuators
  - **Insulating of El. Contacts**
    - Ex. Actuators
  - **Joining Temperature Sensors**
    - Ex. Actuators
  - **Joining Stator / Carrier**
    - Ex. P2 Hybrid Modules
  - **Testing Stator EOL**
    - Ex. IDAM industrial e-motors

- **Stator Manufacturing Processes**
  - **Stamping**
    - Key expertise of Schaeffler
  - **Packetizing**
    - Today BUY, option for MAKE
  - **Joining Magnets**
    - Ex. Actuators
  - **Joining Rotor / Shaft**
    - Ex. CVT
  - **Balancing**
    - Ex. Double Clutch
  - **Magnetizing Incl. Testing**
    - Ex. P2 Hybrid Modules
  - **Testing Rotor EOL**
    - Ex. IDAM industrial e-motors

*Example for possible production process*

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Ready to produce by 2020
Implications for Schaeffler (Engine content only)

**Diesel engine**

- **Emissions**
  - $117.9 \text{ g/km}$ CO$_2$
  - $141\text{–}684 \text{ mg/km}$ NO$_x$

- **Technologies**
  - 2-stage variability
  - Thermal management
  - Standard ICE technology

- **Potential content**: €110

**Gasoline engine**

- **Emissions**
  - $121.6 \text{ g/km}$ CO$_2$
  - $60 \text{ mg/km}$ NO$_x$

- **Technologies**
  - Variable valve train
  - Dual variable cam timer
  - Thermal management

- **Potential content**: €130

**Mild hybrid gasoline (48V)**

- **Emissions**
  - $\sim105 \text{ g/km}$ CO$_2$
  - $50 \text{ mg/km}$ NO$_x$

- **Technologies**
  - Belt alternator starter system (pulley decoupler, mechanical belt tensioner, pendulum design)
  - Dual variable cam timer
  - Variable valve train

- **Potential content**: €150

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**Key aspects**

- Due to driving bans in European cities, the market share of diesel vehicles is likely to decline further and faster than previously expected.
- The necessity to produce more efficient and low-emission (CO$_2$) gasoline engines bears potential for the use of Schaeffler products.
- +30% potential content in 2020 for every diesel engine less produced$^{2,3}$

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$^{1}$ According to RDE measurement of Euro-6-diesel in ADAC EcoTest 2017

$^{2}$ Calculation for business division engine systems only

$^{3}$ Without consideration of potential regarding hybrid modules and e-axles (48V, full hybrid)
**Key aspects**

- The rate of automization of transmissions is increasing rapidly, also due to more hybridization.
- Significant higher potential content in every automated transmission.
- Schaeffler's E-Clutch allows mild hybridization of manual transmissions and offers CO2 saving potential > 8% in conjunction with a P0 48V – First SOP in 2019.

**Transmission market development**

- **Source:** IHS Transmission Forecast (w/o reduction transmissions)

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**Further content per car growth potential in Transmission Systems**
Every four years Schaeffler invites industry specialists for an exclusive event of technical presentations with exciting insights into the technologies and mobility concepts being developed by Schaeffler.

Facts and figures
- ~ 400 customers
- 96 exhibits & 28 technical presentations
- 12 world debuts

Product Highlight – Schaeffler Mover
Chassis meets Powertrain

Key Facts
- Urban vehicle concept
- Flexible and zero-emissions platform for diverse vehicle concepts
- Drive and suspension modules installed in a single unit, "Schaeffler Intelligent Corner Module"
- Easily scalable (vehicle length and width)
- Based on Schaeffler's "Rolling Chassis"
Chassis Product Portfolio

Key aspects

- Chassis megatrends include Autonomous Driving, Zero Fatalities, CO₂ reduction and demographics
- Schaeffler offers wheel and chassis bearings as well as chassis actuators
- Our actuators portfolio allows for Chassis Control, Drive-by-Wire Solutions and Autonomous Driving
- Growing complexity adds value

Potential through autonomy

Further content per car growth potential in Chassis Systems
<table>
<thead>
<tr>
<th>Key Message</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Schaeffler's Accelerated scenario for 2030 is gradually becoming a reference in the automotive industry.</td>
</tr>
<tr>
<td>2</td>
<td>The CO₂ targets can only be achieved through the consistent optimization of the ICE as well as the widespread electrification of the powertrain.</td>
</tr>
<tr>
<td>3</td>
<td>Our vehicle and powertrain expertise, our deep mechanical knowhow and our system/integration understanding are the foundations of our push into electrification.</td>
</tr>
<tr>
<td>4</td>
<td>Schaeffler is set to enter the market at the end of 2020 with its own electric motors.</td>
</tr>
<tr>
<td>5</td>
<td>Automation of powertrains is a prerequisite for autonomous driving – Schaeffler has a higher content per car in this field.</td>
</tr>
<tr>
<td>6</td>
<td>The mid-term future is electric and autonomous - both offer upside potential for Schaeffler.</td>
</tr>
</tbody>
</table>
Thank you for your attention