Zukunftsforum Schweinfurt 2020

3. Februar 2020

CO₂-neutrale und nachhaltige Mobilitätslösungen: Herausforderung und technologieoffener Wettbewerb

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Leiter Forschung & Innovation, Zentrale Technologien
SCHAEFFLER AG
Schaeffler in facts — strong starting point

High quality of results
9.7% EBIT margin in 2018¹

More than 170 locations in 50 countries

Strong customer base with approx. 11,800 customers

1.1 m tons of processed steel p.a.

Approximately EUR 14.2 bn Sales in 2018

Around 89,000 employees worldwide²

More than 2,400 patents filed in 2018

Far more than 10,000 different products

77 plants
20 R&D centers

¹ Before one-off effects ² As at June 30, 2019
**Schaeffler at a glance**

**Schaeffler – a leading global technology company**

**Continuous sales growth from** (in EUR bn)

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>12.1</td>
<td>13.2</td>
<td>13.3</td>
<td>14.0</td>
<td>14.2</td>
</tr>
</tbody>
</table>

**Global footprint**

<table>
<thead>
<tr>
<th>Region</th>
<th>#Plants</th>
<th>#R&amp;D Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>44</td>
<td>12</td>
</tr>
<tr>
<td>Americas</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Greater China</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Asia/Pacific</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>71</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

**Sales by division and region in 2018** (in %)

- **Automotive OEM**: 63.2%
- **Industrial**: 13.0%
- **Automotive Aftermarket**: 23.8%
- **Americas**: 20.2%
- **Greater China**: 18.0%
- **Asia/Pacific**: 10.5%
- **Europe**: 51.3%

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

**Employees worldwide**

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>82,300</td>
<td>84,200</td>
<td>86,600</td>
<td>90,200</td>
<td>92,500</td>
</tr>
<tr>
<td>2014</td>
<td>30,500</td>
<td>30,800</td>
<td>31,200</td>
<td>31,700</td>
<td>32,700</td>
</tr>
</tbody>
</table>
Our success factors – quality, technology and innovation

Schaeffler at a glance

Selected Innovation and Quality Awards 2017/18
- „LOGISTRA best practice: Innovations“
- „Best of Industry“-Award
- DMG Mori „Partner Award 2017“
- Volkswagen „Quality Performance Award“
- GM „Supplier Quality Excellence Award“
- Fiat Chrysler „Outstanding Quality Supplier Award“

First class manufacturing technology
- State-of-the-art plants and testing facilities
- Outstanding know-how in
  - Surface treatment
  - Raw material processing
  - Tool Management & Prototyping/Special machinery building
  - Precision manufacturing

Innovation Networks
- SHARE - Schaeffler Hubs for Advanced Research
  - SHARE at KIT (Karlsruhe Institute for Technology, Germany)
  - SHARE at FAU (Friedrich-Alexander University of Erlangen-Nuremberg, Germany)
  - SHARE at NTU (Nanyang Technological University, Singapore)
  - SHARE at SWJTU (Southwest Jiaotong University, Chengdu, China)
- Silicon Valley Office, U.S. (intensive exchange with start-ups)
- Cooperation with: Munich Network, Plug and Play, ZOLLHOF Tech Incubator Nuremberg

Number of patent applications in Germany¹

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent applications</td>
<td>2,518</td>
<td>2,334</td>
<td>2,316</td>
<td>2,383</td>
<td>2,417</td>
</tr>
</tbody>
</table>

¹ Source: Deutsches Patent- und Markenamt (DPMA)
Three divisions – automotive OEM, Automotive Aftermarket and Industrial

**Automotive OEM | Systems**
- Engine Systems
- Transmission Systems
- Chassis Systems
- Hybrid and Electrical Drive Systems

**Automotive Aftermarket | Segments**
- Passenger Cars
- Light Commercial Vehicles
- Heavy Commercial Vehicles
- Tractors & Agricultural Vehicles
- Services

**Industrial | Sector Clusters**
- Wind
- Raw Materials
- Aerospace
- Railway
- Offroad
- Two Wheelers
- Power Transmission
- Industrial Automation

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Basis for strategic direction – four focus areas

**Eco-friendly drives**
- Optimized combustion engine
- Electric vehicles
- Industrial drives

**Urban mobility**
- Two-wheelers
- Inner-city railways
- Micro mobiles

**Interurban mobility**
- Rail vehicles
- Aircraft
- Off-highway

**Energy chain**
- Wind power
- Solar power
- Conventional power generation

**Mobility for tomorrow**
New eco-systems require holistic competences from energy generation to energy consumption.
**Zero CO₂ Mobility**

**Future scenario powertrain**

**30 – 40 – 30 Scenario**
Global vehicle production [in mn units]

- 2017: 95% ICE, 4% HEV, 11% EV
- 2020 e: 95% ICE, 11% HEV, 4% EV
- 2025 e: 55% ICE, 33% HEV, 12% EV
- 2030 e: 30% ICE, 30% HEV, 40% EV

**30 – 40 – 30 Scenario in 2030**
Global vehicle production [in mn units]

- EMEA: 37% ICE, 36% HEV, 19% EV
- North America: 10% ICE, 26% HEV, 55% EV
- South America: 1% ICE, 1% HEV, 98% EV
- Greater China: 20% ICE, 21% HEV, 55% EV
- India: 23% ICE, 27% HEV, 56% EV
- Korea: 25% ICE, 17% HEV, 52% EV
- Japan: 15% ICE, 33% HEV, 52% EV
- SEA: 6% ICE, 1% HEV, 93% EV
Zero CO₂ Mobility
Fuel diversity and uses for sustainable mobility

BEV
- Buses
- Mover
- City logistics
- Personal LEV
- MicroMobility

HV/PHV
- Route buses
- Passenger cars

FCEV
- Trucks

Vehicle size vs. Travel distance

Fuel
- Electricity
- Gasoline, diesel, biofuels, CNG, synthetic fuels etc.
- Hydrogen
Execution of an ambidexterity approach by a twin-track strategy
Global market orientation leads to twin-track strategy

- CO₂ reduction / fuel economy
- Synthetic fuels
- Performance enhancement

Internal Combustion Engine

E-mobility (PHEV, BEV, FC)

- Build up competences
- Mass production
- Technological leadership
A sustainable energy chain with hydrogen offers great potentials

"green" energy

volatile nature

Carbon CO₂

electrolysis

synthetic fuels

Internal combustion engine

conversion into electric energy

energy storage

e-mobility (battery electric)

Fuel cell

e-mobility (fuel cell)
Global market orientation leads to twin-track strategy

Electricity-based CO2 neutral mobility

- CO₂ reduction / fuel economy
- Synthetic e-fuels
- Performance enhancement
- Build up competences
- Mass production
- Technological leadership
**Schaeffler’s portfolio of components for the electrified powertrain**

<table>
<thead>
<tr>
<th>Level of electrification</th>
<th>MICRO HEV</th>
<th>MILD HEV</th>
<th>PHEV</th>
<th>XEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Belt-Driven Starter Generator Layout</td>
<td>eRocker</td>
<td>UniAir</td>
<td>Pure electric drive</td>
</tr>
<tr>
<td>Transmission</td>
<td>Double Clutch</td>
<td>E-Clutch</td>
<td>Modular Clutch Actuator (MCA)</td>
<td></td>
</tr>
<tr>
<td>E-Mobility</td>
<td>48 V-Hybrid Module</td>
<td>Hybrid Transmission MultiMode</td>
<td>Smart Hydraulic</td>
<td>400 V E-Motor</td>
</tr>
<tr>
<td>Chassis</td>
<td>CHASSIS AUTOMATION</td>
<td>NEW MOBILITY CONCEPTS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fuel cell technology – what Schaeffler is doing

Sustainable Mobility

**Fuel Cell: An On-Board Electric Power Plant**

Schaeffler accepts as steering member in the Hydrogen Council. Hydrogen technology to be driven forward in direction of mass market. Schaeffler develops and manufactures key components for hydrogen powered fuel cells.

**H₂ IN THE ENERGY CHAIN**

Clean machine: H₂ is obtained from water by electrolysis. With its high energy density, low weight and fast refueling times, the energy carrier acts as a powerful and efficient fuel – 100% emission-free.

**AN EVERLASTING SOURCE**

The earth’s resources of hydrogen – bound in water – are almost unlimited. If “green” electricity is used for electrolysis, the obtained H₂ fuel is sustainable.

**COMPONENT LEVEL**

Schaeffler has manufacturing expertise and know-how across all process steps of fuel cell production. Bipolar plates are produced by precise forming and casting in the nanometer range. Once stacked, these form the core of the fuel cell.

**MODULE AND SYSTEM LEVEL**

Serving as energy converters, fuel cell stacks let H₂ react with O₂ to form water – the energy from which powers the vehicle’s e-motor. Based on its system expertise, Schaeffler provides high-performance control units, low-friction bearings and thermal management modules to make fuel cells even more efficient.

**Schaeffler activities**

- Schaeffler accepted as steering member in the Hydrogen Council
- Hydrogen technology to be driven forward together in direction of mass market
- Schaeffler develops and manufactures key components for hydrogen powered fuel cells
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Zero CO₂ Mobility

Electronic Chain / Elektronische Kette
Formula E – best conditions to further develop e-mobility in a competitive environment
Our vision of urban mobility

- Emission-free
- Connected
- Automated
- Shared
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