Leading the Transformation.

Investor Update, Wolfsburg, 19th August 2019
Digital Car & Services
Christian Senger

Board Member Digital Car & Services
Volkswagen Passenger Cars
Agenda

1. Situation
2. Organization
3. Collaboration
Platform strategy is key to technology leadership and scalability.

Volkswagen is the pioneer for platform development.
70 ECU’s per car ...
200 SW Suppliers...
... 8 electric architectures
countless connections between ECU’s and SW-Functions

Resulting in:

- Paralyzing amount of complexity
- Updates are not possible
- Inability to harvest economies of scale

... We need CHANGE!
Today the in car software is developed without a unified operating system or a standard platform.

Smartphone Architecture:
- Apps: Weather, Maps, Shopping, Chat, Video, Clock
- Platform: App Store, iOS, SDK, Framework
- Hardware: Smartphones

Universal standard interface: Connection between apps and hardware

Hardware-specific communication: Communication with specific hardware devices

Car Architecture:
- Mobility Services: Drivetrain, ADAS/AD, AP, In-Tainment, Connect, Energy/Charging, Comfort
- Electronics, Mechanics

Lack of “one language” for communication between apps and hardware.
We need to copy the IT-Industry and develop functions on a group wide platform.
Embedding car.SW Org into the Group Structure in 2019

Brands

- Car Application
- Car Application
- Car Application

Software Requirements

car.SW Org

SW-Unit on equal terms with the brands

SW Platform & Services
Agenda

1. Situation
2. Organization
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Software contributes to the brand success by its own roadmap and development cycles.
We are going through a huge transformation…

© powered by car.SW OS

... TOGETHER!
Climate Change is the biggest challenge of our time

Increasing man-made temperature rise

Constantly rising sea levels

Growing number of natural disasters
Besides other economic sectors, the transport sector will contribute to reducing global greenhouse gas emissions.

Global emissions by economic sector:

- 25% Electricity Generation
- 24% Agriculture and Forestry
- 21% Industry
- 14% Transport
- 10% Other Sectors
- 6% Residential and Commercial
- 25% Agriculture and Forestry

Goal: Reduce CO$_2$ emissions from transport to zero by 2050 at the latest.

Source: Intergovernmental Panel on Climate Change IPCC
Retrograde target derivation based on the Paris Climate Agreement requires effective transformation planning.

Paris implications and transformation path:

- Conventional platforms
- Conventional projects

Transformation path:

- SOP
- EOP

2020-2050 transition:
- CO₂ emissions
- BEV
- Zero CO₂

>10 years Fleet renewal

“Zero Emission” in the existing fleet
Volkswagen Group has launched the largest electric offensive in the global automotive industry

Global Market offer

~70 New full electric models

~30 bn. invest

~22 m. cars

1st wave

- Mission E Cross Turismo
- MEB Entry Family
- e-tron GT
- ID. Buzz
- ID. Vizzion
- Vision E
- ID.3
- e-tron Sportback concept
- e-tron
- ID. Crozz
- Taycan
Electric for all: The SOP of the Volkswagen ID.3 at the end of 2019 marks the start of a new era.
The MEB electric platform is the technological and economic backbone of the e-offensive

By 2022, we will be offering pure electric models in all relevant vehicle segments
We are planning up to 15 Million MEB-based vehicles in the first wave...
Volkswagen consistently implements its MEB strategy in the production sites

Ramp up of 8 MEB locations until 2022:

- Chattanooga, USA
- Emden, Germany
- Hannover, Germany
- Zwickau, Germany
- Dresden, Germany
- Mladá Boleslav, Czech Republic
- Anting, China
- Foshan, China
The Volkswagen plant Zwickau will step-by-step be transformed into an MEB-only site.

Volkswagen invests more than 1.2 Billion Euros at the Zwickau site.
MEB Transformation in Zwickau ongoing

Organizational basis set

Volkswagen Sachsen

Direct organisational connection to Head of Brand Board division „E-Mobility“

Construction work in full swing

More than 67% already contracted and spent

328 Pre-series cars already built
Nevertheless: In society, politics and industry there are concerns regarding the E-Mobility transformation ... 

1. A lot of CO₂ arises from the battery and car production
2. We don’t have enough power
3. Without green energy there is no difference
4. E-Mobility is too expensive
5. Range is too small, it shrinks in Winter
6. Number of loading facilities is not sufficient
7. Charging takes too long
8. Durability of the battery is short and is then special waste
A lot of CO$_2$ arises from the battery and car production.

The first steps towards a CO$_2$-neutral society have been taken, the ID. will be handed over CO$_2$-neutral to customers in EU.

- **Supply chain**: 100 % green power in battery cell production
- **Production**: 100 % green power at Zwickau factory
- **Use**: Volkswagen Naturstrom by Elli
- **Recycling**: 100 % green power in battery cell production
The first steps towards a CO$_2$-neutral society have been taken, the ID. will be handed over CO$_2$-neutral to customers in EU.
Talking about green energy – its share is increasing worldwide!

The lights will not go out – There is enough power!

The German Federal Government announced 1 million electric vehicles in Germany by the end of 2022. These will increase the power consumption by only 0.5%.

Even today, the global power mix makes e-mobility greener than any combustion engine. According to BloombergNEF the overall share of sustainable energy supply will be 63% by 2040.
The ID. will be available on same TCO level as a comparable Golf

Entry price **under 30,000 €**

Focus on customer loyalty on the **total lifecycle** (new: Leasing for 2\textsuperscript{nd} lifecycle)

First BEV in the **volume relevant** A-segment price range

Higher sales price versus conventional cars will be compensated by **lower running costs** of the BEV

**ID. affordable**

As a VW Golf Diesel

* Leasingraten & Restwerte ähnlich Golf

Cost increase ICE cars due to EU7
Range is too small, it shrinks in Winter

The MEB offers scalable range suitable for everyday use, even in bad weather conditions.

High battery range:
- **23°C**: 550 km
- **35°C**: 90% (490 km*)
- **-7°C**: 70% (390 km**)

* Heating / air condition; ventilation; light; radio; navigation; seat heating (Winter)

** additional: All season tires

WLTP = Ø 48 km/h

330 km WLTP up to 550 km WLTP
Volkswagen has defined a use-case derived charging strategy

- **@Home**: 50% of use cases
- **@Work**: 20% of use cases
- **@Public**: 25% of use cases
- **@Highway**: 5% of use cases

6 Number of loading facilities is **not sufficient**
Volkswagen offers green charging solutions in a digital environment

Number of loading facilities is **not sufficient**

@Home

Wallbox

Billing

Green Energy

Installation
### VW Facility Charging | Target State 2025

**Target number of charging points 2025**

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<td>AC</td>
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<tr>
<td>DC</td>
<td>~50</td>
</tr>
<tr>
<td>AFC</td>
<td>~40</td>
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</table>

For the Group in Europe incl. dealers: 36,000

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AC: Alternating Current; DC: Direct Current; AFC: Autonomous flexible Charging column
150 thousand available charging points in the ID. Core markets (Feb ’19)

Focus Germany
- Current state 2019: 20,650
- Target „Koalitionsvertrag“ 2020: + 100,000
- Necessary according to NPE* estimation 2025: 140,000-210,000

Master plan E-Mobility instead of “finger-pointing”

Source: eafo.eu; * Neue Plattform Elektromobilität: Premise: stock of 2-3 million electric cars; number of charging point outside Germany: rounded
Politics has recognized the importance of charging infrastructure

„I want charging to be possible for whoever and whereever. We have to address this issue.“
Federal Minister of Transport Andreas Scheuer, April 2019

„The state has to accompany the expensive investments of the automotive industry with the expansion of charging infrastructure and fiscal benefits.“
Federal Minister of Finance Olaf Scholz, March 2019
IONITY is a Joint Venture for the development of a European fast-charging network

350 kW charging capacity

2,400 charging points by 2020 along major traffic arteries in Europe
Charging takes too long

High Power Charging (HPC) enables long ranges with short charging periods. MEB with up to 125kW charging capacity on premium level

- E-Golf
  - 233 km*
  - 50 kW
  - 60 Min.
  - 233 km*
  - 50 kW
  - 60 Min.
  - 233 km*
  - 700 km
  - Charging period: 120 min

- ID.
  - 350 km*
  - 125 kW
  - < 35 Min
  - 350 km*
  - 700 km
  - Charging period < 35 min

- CCS Standard
- Charging capacity up to 50kW

- High Power DC (z. B. Ionity)
- CCS Standard
- MEB charging capacity up to 125kW

* Driving distance illustrative
Volkswagen guarantees a long performance of the battery, the battery offers additional profit pools through 2nd life applications and recycling

1) Drive batteries' durability is longer than 1st life lifecycle
2) We're aiming to return the batteries at End-of-Use for 2nd use and/or recycling
8 Durability of the battery is short and is then **special waste**

The battery will be used in 2nd life applications outside the car, relevant parts of the value creation process and recycling are in-house.