“Charging for all” – the key to the market success of e-mobility

Thomas Ulbrich
Board Member E-Mobility, Volkswagen Brand
Climate change is the biggest challenge of our time

- Increase in man-made global warming
- Continuous rise in sea level
- Growing number of natural disasters
- Damages in total amounting to \(160,000,000,000\) $
Volkswagen has begun the transformation to a carbon-neutral company.

Conventional platforms → SOP → Conventional projects
Conventional projects → SOP → Fleet renewal
Fleet renewal → EOP

Product portfolio

Transformation

CO₂-neutral vehicles

CO₂ emissions

• BEV
• FCEV
• PHEV

2020

2050

“Zero emission” fleet in operation

These vehicles are not yet for sale in Europe.
The largest electric offensive in the global automotive industry is at the heart of our strategy.

- ~70 new fully electric models through 2028
- ~30 billion euros invested through 2023
- ~22 million vehicles through 2028
- 18 e-sites worldwide, incl. 8 MEB plants
- ~1 billion euros for battery cell production
- ~250 million euros for charging infrastructure

These vehicles are not yet for sale in Europe.
But: there are still some prejudices about e-mobility

#1 Price: “EVs are too expensive!”

#2 Range: “The range is too short!”

#3 Product: “EVs aren’t attractive!”

#4 Environment: “EVs aren't clean either!”

#5 Charging: “There aren’t enough charging stations!”
The ID.3 removes most of these prejudices...

#1 Price: under €30,000

#2 Range: 330-550 km (WLTP)

#3 Product: augmented reality & much more

#4 Environment: carbon-neutral balance

...and we are paving the way for the breakthrough of e-mobility

This vehicle is not yet for sale in Europe.
We are optimizing CO₂ reduction throughout the entire ID.3 value chain

**CO₂ supply chain and production**

- Energy efficiency Zwickau
- Green power Zwickau
- Green power further suppliers
- Green power cell production HV batteries

**carbon-neutral footprint**

**Customer handover**

**Avoid & reduce**

**Offset unavoidable emissions**

1) Certified projects, e.g. VCS (Verified Carbon Standard) or REDD+ (Reducing Emissions from Deforestation and Forest Degradation)

This vehicle is not yet for sale in Europe.
Currently, the charging structure is the critical success factor for the breakthrough of e-mobility in Germany.

- **#1 Price** ✓
- **#2 Range** ✓
- **#3 Product** ✓
- **#4 Environment**
- **#5 Charging** ❌

### Charging anxieties of customers

- Insufficient number of charging stations: 76%
- Charging times too long: 73%
- Not enough fast charging stations: 68%
- No charging station standard: 49%
- Different payment systems: 38%

Source: AUTO BILD
The goal of more than 100,000 charging stations is still a long way off as per coalition agreement.
Infrastructure expansion must cover all main charging situations

@Home
- Charging when parked (50% of charging operations)

@Work
- Charging during stop (20% of charging operations)

@Public
- Charging when parked (25% of charging operations)
- Charging during stop-over (5% of charging operations)

@Highway
- Charging when parked

This vehicle is not yet for sale in Europe.
Volkswagen is investing some €250 million in expanding the charging infrastructure across Europe:

- **36,000 charging points** at sites and at dealers in Europe (many public)
- **Access to over 100,000 charging points** in Europe
- **400 charging stations** on major highways

**Affordable wallboxes** incl. Volkswagen Naturstrom®

This vehicle is not yet for sale in Europe.
Charging at home: Volkswagen occupies the strategic business area of charging with Elli
Charging at work: Volkswagen is installing some 4,000 charging points at German plants

Number of charging points in 2025 (target):

- AC ~3,950
- DC ~50
- AFC ~40
Volkswagen is installing public charge bays:

- Charging points at all 3,000 Volkswagen dealers in Europe
- Cooperation with retailers (e.g. Tesco/UK)
- Flexible fast charging bays
- We Charge app with access to 100,000 charging points in Europe

Cooperation with Tesco/UK
600 stores
2,400 charging points
Charging on highways: Volkswagen is committed to high power charging through participation in IONITY

- Europe-wide fast charging network
- 400 charging stations with up to 2,400 charging points
- Charging every 200 kilometers
- Flat-rate fee: currently 8 euros per charge

This vehicle is not yet for sale in Europe.
Politics has recognized the importance of the charging infrastructure

“\textit{I want charging to be available to everyone everywhere. It’s time now to tackle charging.}”

Andreas Scheuer, Federal Minister of Transport, April 2019
Targeted measures can significantly speed up charging infrastructure expansion

<table>
<thead>
<tr>
<th>HOME</th>
<th>WORK</th>
<th>PUBLIC</th>
<th>HIGHWAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Support introduction</td>
<td>• Start supporting introduction</td>
<td>• Support for parking spaces, parking lots, etc.</td>
<td>• Swifter approval</td>
</tr>
<tr>
<td>• WEG</td>
<td></td>
<td>• 12/6 instead of 24/7</td>
<td>• Specifications for service stations</td>
</tr>
<tr>
<td>• Regulation on building efficiency</td>
<td></td>
<td>• Sanctioning of illegal parking</td>
<td></td>
</tr>
<tr>
<td>• Right to charging infrastructure</td>
<td></td>
<td>• Right to charging infrastructure</td>
<td></td>
</tr>
</tbody>
</table>

**SHORT-TERM**

2019-2020

- Support introduction
- WEG
- Regulation on building efficiency
- Right to charging infrastructure

**MEDIUM-TERM**

2020

- (Phased) Support for intelligent charging points
- (Phased) Support for intelligent charging points
- Regulation on building efficiency
- Calibration law
- Exemption from construction permits for projects
- Include service areas with no amenities

This vehicle is not yet for sale in Europe.
The energy transition also needs a powerful boost

It’s all about the mix: EV eco-balance (g/km over lifecycle)

<table>
<thead>
<tr>
<th></th>
<th>Power</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind power</td>
<td>57</td>
<td>2</td>
</tr>
<tr>
<td>Mix EU 28</td>
<td>62</td>
<td>57</td>
</tr>
<tr>
<td>Mix Germany</td>
<td>85</td>
<td>57</td>
</tr>
</tbody>
</table>

Basic assumption: e-Golf with mileage of 200,000 kilometers
SUMMARY: We need concerted action now in Germany to achieve the breakthrough of e-mobility!

Masterplan E-mobility
Focus on charging infrastructure
Is the charging structure adequate – and what needs to be done?

Stefan Schmerbeck
Technology & Future Mobility External Relations
More visible charging infrastructure creates customer confidence—this infrastructure will be needed later for the market run-up.

- **Target under coalition agreement**: 100,000 charging points in 2020 (~50,000 charging stations)
- **Minimum requirements according to NPE**: 130,000 AC/13,000 DC charging points (~78,000 charging stations)
- **Financed development**: 70,000 AC/7,100 DC charging points (~42,000 charging stations)

**Shortfall:** About 66,000 charging points

Electric cars per charging point (2015 – 2018):
- Germany: 5.5, 4.5, 3.8, 5.2
- Proactive development: 1.2, 0.9, 1.3, 1.5

Sources: NPE progress report 2018, Coalition Agreement 2018, Institut der deutschen Wirtschaft Köln e.V., 2018
First step (with immediate effect): develop public charging infrastructure

- More publicly accessible, visible charging points are the top priority for 2019 and 2020
- 100,000 charging points will be needed by 2020 – mainly in urban areas
- The charging stations we will need tomorrow must be built today – to combat charging anxiety
- Clear responsibilities, positioning, coordination and cost distribution requirements are needed for states and local authorities – to be steered and (co-)financed by federal government

This vehicle is not yet for sale in Europe.
Second step (from 2020): develop private charging infrastructure

- Law concerning tenancy agreements and home ownership: implement rights to install private charging points
- Dismantle administrative obstacles to development of charging infrastructure
- Weights and measures law: no dismantling of existing charging infrastructure, facilitation of practicable billing systems
- Building Efficiency Ordinance: obligation to develop charging infrastructure (new and existing buildings)
- Extension of Subsidy Ordinance: inclusion of retail trade, subsidies for private charging infrastructure
For rapid infrastructure development, even stronger commitment is called for

### HOME
- 50% of users
- Support introduction
- WEG
- Regulation on building efficiency
- Right to charging infrastructure

### WORK
- 20% of users
- Start support for introduction

### PUBLIC
- 25% of users
- Support for parking spaces, parking lots, etc.
- 12/6 instead of 24/7
- Sanctioning of illegal parking

### HIGHWAY
- 5% of users
- (Phased) Support for intelligent charging points
- Regulation on building efficiency
- Calibration law
- Exemption from construction permits for projects

<table>
<thead>
<tr>
<th>SHORT-TERM</th>
<th>MEDIUM-TERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019-2020</td>
<td>2020</td>
</tr>
</tbody>
</table>

- (Phased) Support for intelligent charging points
- Caliberation law
- Exemption from construction permits for projects
- Include service areas with no amenities

This vehicle is not yet for sale in Europe.
We need to send out a signal against charging anxiety/reservations.

100,000 additional charging points needed by 2020.

More Norway and less bureaucracy in Germany.

Politicians must lay the foundations by the summer.

This vehicle is not yet for sale in Europe.
Is there enough power – and when is it green?

Karsten Miede
Head of E-Mobility Services,
VW Kraftwerk GmbH
We have been active in the energy market for many years – VW Kraftwerk GmbH has decades of experience within the Group.

- Departure from coal: two power plants in Wolfsburg to be changed over to natural gas for €400 million.
- Change will save 1.5 million tonnes of CO₂ per year – corresponding to about 870,000 cars.
- CO₂ avoidance costs per tonne only €14.
Electric car has four times the range with comparable energy input

1 According to DEKRA 1 liter of diesel produces 2.65 kg of CO₂ emissions | 2 According to European Energy Agency (EEA) 0.296 kg per kWh in EU mix

ID.3 - This vehicle is not yet for sale in Europe.
There is enough power – but the energy transition must be accelerated for climate protection reasons

1. By 2050, the share of energy from renewable sources is to reach about 90%

2. Power users are becoming increasingly efficient: savings of 25% by 2020

3. 1 million more BEVs per year will only boost power consumption in Germany by 0.5% per year
When is green power really green? Expansion of renewable energies: with subsidies and as a result of genuine demand

- The more consumers purchase green power, the greener will the power lake become.
- Plants subsidized under Renewable Energy Act lose the possibility of generating green power.
- Only the (non-subsidized) expansion of renewables with the objective of supporting the traffic transition can guarantee CO$_2$-free individual mobility in the long term.
E-mobility offers flexibility for the power sector – but power grids must continue to be expanded

Bidirectional charging creates the short-term buffer needed for harmonizing generation from renewable sources with demand

The myth of affluent electric suburbia. Existing grid can cover additional demand but intelligent grid expansion will be necessary

Networking of photovoltaics, battery storage in the home and electric vehicles becomes relevant

This vehicle is not yet for sale in Europe.
There is enough power, but the energy transition needs to be accelerated.

Grids will provide the power, if they are adequately expanded.

EV can be integrated in smart networks.

Customers benefit from “behavior in line with system requirements”.

This vehicle is not yet for sale in Europe.
When will charging become simple, convenient and affordable?

Martin Roemheld
Head of E-Mobility Services, Volkswagen
Customers perceive e-mobility differently

Customers’ perceptions

Positive
“E-mobility fits in with my mobility behavior”

Negative
“For me, e-mobility is not practicable”

Range up to 550 km

Customers’ view of range

Customers’ view of charging

Charging once per week

Growing number of charging points

This vehicle is not yet for sale in Europe.
The ID.3 will finally make e-mobility fit for everyday and leisure use

<table>
<thead>
<tr>
<th>Everyday use</th>
<th>Weekends</th>
<th>Vacations</th>
</tr>
</thead>
<tbody>
<tr>
<td>~30 km per day</td>
<td>~500 km at weekend</td>
<td>&gt;1,000 km distance from destination</td>
</tr>
<tr>
<td><strong>Urban</strong></td>
<td><strong>Regional/national</strong></td>
<td><strong>International</strong></td>
</tr>
<tr>
<td>15 km Berlin</td>
<td>225 km Rostock</td>
<td>~1,030 km Berlin</td>
</tr>
<tr>
<td>420 km</td>
<td>225 km</td>
<td>350 km - 240 km</td>
</tr>
<tr>
<td><strong>Charging once per 14 days</strong></td>
<td><strong>Charging at destination</strong></td>
<td><strong>Charging in breaks</strong></td>
</tr>
<tr>
<td>2,3 kW</td>
<td>At home</td>
<td>At destination</td>
</tr>
<tr>
<td>11 kW</td>
<td>At home</td>
<td>At destination</td>
</tr>
<tr>
<td>50 kW</td>
<td>During shopping</td>
<td>At destination</td>
</tr>
<tr>
<td>100 kW</td>
<td>On highway</td>
<td>During break</td>
</tr>
</tbody>
</table>

idealized presentation – real values may be different
Volkswagen offers suitable charging solutions for all situations

<table>
<thead>
<tr>
<th>Situation</th>
<th>Everyday use</th>
<th>Weekend</th>
<th>Vacation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>~ 30 km</td>
<td>Up to 500 km</td>
<td>&gt; 1,000 km</td>
</tr>
<tr>
<td>@Home</td>
<td>Wallbox charging with 11kW when required</td>
<td>(nighttime) charging before trip: start with ~100% range</td>
<td></td>
</tr>
<tr>
<td>@Work</td>
<td>Charging in line with supply and demand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@Public</td>
<td>Public charging points (Roadside, supermarkets, …)</td>
<td>(Semi-)public charging points at destination – throughout the EU (hotels, attractions, …)</td>
<td></td>
</tr>
<tr>
<td>@Highway</td>
<td>Fast charging along route – throughout the EU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This vehicle is not yet for sale in Europe.
The Volkswagen full-service offering for home charging

@Home

Wallbox + installation from a single source:
ordering, testing of power connection, installation, service

Fast, convenient and safe charging with up to
11 kW, optionally with green power from Elli

In some cases, subsidy for charging infrastructure in private homes (regional)

One charging operation per week adequate for commuting distances – Wallbox can be used by several vehicles

This vehicle is not yet for sale in Europe.
Charging at work – another possibility

- Wallbox designed for invoicing incl. monitoring and control functions
- By 2025, Volkswagen is to install over 4,000 charging points for employees at German Volkswagen locations
- Stationary time is used for charging – no restrictions on use
- Low capacity adequate with daily use, low investment by employer
- Power can be provided by the employer tax-free

This vehicle is not yet for sale in Europe.
Volkswagen contributes to the development of public charging infrastructure

**Employee car parks**
Now: about 600 charging points
2025: about 4,000 charging points

**Advice for fleet customers**
Requirements, costs, regulations, management

**Charging at Volkswagen dealerships**
All 3,000 dealers and service points in the EU are to be equipped by 2020

**Public charging**
Action is needed!

ID. Family: These vehicles are not yet for sale in Europe.
e-Golf: Power consumption, kWh/100 km: combined 14.1 with 17-inch wheels – 13.2 16-inch; CO₂ emissions, combined, g/km: 0; efficiency class: A+
Charging @Destination becoming increasingly important

In future access to **150,000 public charging points** in Europe via **We Charge**

**Charging possibilities** at all **Volkswagen dealerships** in Germany

- Simply electrifying everywhere: 400 electric charging stations at Lidl branches by March 2020
- Press release: Aldi Süd develops nationwide network of charging points
- Kaufland opens 100th fast charging station for electric cars
- Charging eco-power free-of-charge at IKEA – all outlets to have electric charging stations by mid-March

**Visit:**
- @Home: daily/weekly
- @Work: sporadic
- @Public: daily/weekly
- @Highway: sporadic

*This vehicle is not yet for sale in Europe.*
Expansion in the cities has not yet been completed

Coverage of demand by public charging points in the 10 largest German cities

- Massive boost to expansion over the past six months
- Demand for public charging infrastructure in the cities currently not met!
Charging to become customer loyalty tool

**Retail outlets**
15 min at 11 kW enough for journey home

**Hotel**
11 kW for full charging overnight

**Shopping mall/outlet center**
11 kW for top-up charging, 100 kW for weekly charging or break in journey

**Restaurant**
Top-up charging in city

**Full charging in 30 to 45 minutes with 100 kW along major routes**
High network density and charging performance make electric cars suitable for long trips

More than 200 additional locations in Germany in the Tank & Rast network, with ratings of at least 50 kW

Further fast charging networks with up to 350 kW under development – competition has been created!

1) Germany: 100% eco-power, throughout EU, eco-power where technically feasible and available
Berlin – Munich? No problem with the ID.3!

1. ID.3 fully charged and set to right temperature for departure

2. 30-minute charging break at IONITY charging station coffee break

3. Recharging at destination with We Charge
   AC charging overnight

345 km + 240 km = 585 km

This vehicle is not yet for sale in Europe.
HPC as an alternative in the city

HPC for cities

- Fast charging >100 kW: from the highway to the cities
- Alternative charging option for street parkers

Good for networks

- Fast charging units use the medium-voltage grid
- This relieves the burden on the low-voltage grid (service connections)

Pilot project starting now

- Volkswagen is building the first fast charging units in Wolfsburg!
- 5 locations, 28 stations, part of €10 million investment
- Opening on June 25
Upon the market launch of the ID.3, charging is simple, convenient and affordable.

- **At home**: Green power and Wallbox
- **On the road/public**: Access/billing and route planning
  - Occasional charging: Semi-public
  - Long-distance charging: Highway

This vehicle is not yet for sale in Europe.
Upon the market launch of the ID.3, charging is simple, convenient and affordable.

The number of charging opportunities is growing.

We Charge allows charging throughout Europe with only one contract.

Long-distance travel will become a normal part of e-mobility.

Still regional need for action for the expansion of charging infrastructure.

This vehicle is not yet for sale in Europe.
New business models for innovative energy solutions

Thorsten Nicklass
CEO Elli
Volkswagen Group has bundled charging and energy solutions in Elli

Elli stands for *Electric Life*

When energy meets mobility – Elli will be there

Mission is to firmly place e-mobility in the mainstream

2018
Company established, first product portfolio developed

January 8, 2019
Communication kickoff

January 29, 2019
First product - Volkswagen Naturstrom® - becomes available

Elli – empowering electric life
Elli offers charging solutions for main applications

**Charging @Home**
- Charging Infrastructure
  - Installation Services
  - Green Energy

**Charging @Work**
- Project Consulting
  - Fleet Hardware
  - Charging Management

**Charging @Public**
- Charging App
  - Charging Card
  - Billing Services
Blending the digital world, mobility and energy – the foundation for new, data-driven business models
Electric vehicles become intelligent, flexible energy storage units

Many customers generate their own energy

Going forward, EVs can help balance energy supply and demand

Energy increasingly provided by unpredictable sources
Smart electric vehicles can distribute energy – that has several advantages

- Grid stabilization
- Grid optimization
- Reducing energy costs
- Reducing CO₂ emissions
Elli business models based on vehicle and energy data

**B2C business model**
- Grid stimuli
- Intraday market incentives
- EV responds, stores or releases power
- Power system is optimized, financial benefit for customer

**B2B business model**
- Employer releases power to employee EVs
- EVs function as mobile energy storage units
- Employees can take power they generate to work

Elli – empowering electric life
Summary

- The digital world, mobility and energy are coming together
- Elli offers smart charging solutions and energy from renewable sources
- Portfolio spans green power, wallboxes, services and consulting
- With Elli, Volkswagen has a presence in a strategically relevant, very exciting business field
- Volkswagen is therefore harnessing opportunities to retain existing customer groups and develop new ones
Innovative charging solutions for tomorrow

Gunnar Bärwaldt
Portfolio Management e-Mobility Services
Volkswagen Brand
The future with Plug & Charge: EVs become credit cards on wheels

Charging by card today

1. Take card out
2. Plug in
3. Tap card on device
4. Put card away

Charging with Plug & Charge tomorrow

Fully automatic

- Car pays automatically via digital interface and block chain technology
- No need for charging card or app
- Charging becomes so much easier

This vehicle is not yet for sale in Europe.
We Charge finds and books Plug & Charge-compatible charging points

- Charging point identified – can be booked if not in use

- Charging point presented in head-up display and announced by voice assistant

- Vouchers and special offers displayed during charging
The future with charging robots: alternative to inductive charging

- Supports automated parking
- Attractive price-performance ratio
- Couldn’t get any easier than this!

1. Garage door opens
2. Drive forward until…
3. Robot arm extends…

… charging zone projected
… correctly positioned
… and charging begins
… fully automated
In future bi-directional charging will integrate EVs in power grid

<table>
<thead>
<tr>
<th>Function</th>
<th>Energy</th>
<th>House</th>
<th>Car</th>
<th>today</th>
<th>tomorrow</th>
<th>beyond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic</td>
<td></td>
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</table>

Management of entire power consumption

Discharge function

This vehicle is not yet for sale in Europe.
EVs are relevant at all levels of the energy system

local B2C
- e.g. private consumption optimization

local B2B
- e.g. peak shaving management

regional
- e.g. maintaining voltage and regional storage of renewables

national
- e.g. improving capacity utilization of power lines
Summary

Charging with the ID. is simple and convenient – and will be even easier looking further ahead.

Plug & Charge turns the EV into a credit card on wheels.

Robots take the hassle out of fiddling with plugs.

Functional integration of EVs makes the energy system more flexible.

Bi-directional charging increases value of e-mobility in the longer term.

This vehicle is not yet for sale in Europe.