Volkswagen

ID. Workshop

ELECTRIC FOR ALL

Dresden, September 2018

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Note:

This press release along with key visuals and films on electric mobility at Volkswagen are available online at www.volkswagen-newsroom.com

[1]e-up! - electrical consumption in kWh/100km: 11.7 combined; CO2 emissions in g/km: 0 combined, efficiency class: A+.
[2]e-Golf - Electrical consumption in kWh/100 km: combined 12.7, CO2 emissions combined in g/km: 0, efficiency class: A+.
[3]Golf GTE - fuel consumption in l/100km: combined 1.8 - 1.6; power consumption in kWh/100km: combined 12.0 -11.4; CO2 emissions combined in g/km: 40 - 36; efficiency class: A+.
[4]Passat GTE - fuel consumption in l/100 km: combined 1.8 - 1.7; power consumption in kWh/100 km: combined 13.7 - 13.2; CO2 emissions combined in g/km: 40 - 38; efficiency class: A+.
[5]Passat GTE Variant - fuel consumption, l/100 km: combined 1.8 - 1.7; power consumption in kWh/100 km: combined 13.9 - 13.4; CO2 emissions combined in g/km: 40 - 38; efficiency class: A+.

To the point

ELECTRIC FOR ALL:

Volkswagen is accelerating the breakthrough of e-mobility

Important facts on MEB and on the ID. family

- Volkswagen is launching its public relations campaign ELECTRIC FOR ALL: The ID. family is set to make e-cars affordable for millions of people.
- A breakthrough for e-mobility: a sales volume of 150,000 e-cars is planned for 2020. This is set to rise to over one million by 2025.
- It all starts in 2020. The ID. and the ID. SUV will be the first models ofthe new generation of e-cars and will make their premiere together in the same year.
- 100% electric: The ID. family is based on the modular electric drive matrix (MEB), developed especially for purely electric vehicles.
- No compromises: The ID. family pushes the boundaries of e-mobility in terms of range, interior space and dynamics.
- A new standard: The first wave across all brands will include around 10 million e-cars based on MEB technology.
- Update-compatible hardware and software: New E^3 end-to-end electronics architecture and a new operating system – called vw.OS – for the ID. family.
- Newly developed battery system: The ID. family comes with powerful, scalable batteries.
- Scalable batteries: The battery's modular layout allows scalable ranges from about 330 up to more than 550 kilometers.
- Major investment: Volkswagen is investing 6 billion euros into e-mobility, of which 1.3 billion euros is budgeted for component production plants in Braunschweig, Salzgitter and Kassel.
- Charging infrastructure: Volkswagen is a member of IONITY, a joint venture working to develop and expand the network of charging stations on motorways throughout Europe.

Turning point

Individual mobility is on the threshold of a new era: Electric drives and digitisation are set to bring about the most fundamental change the car industry has ever seen in its over 100 year history. Vehicle technology and infrastructure will be subject to radical change, and value chains will shift. This momentum can be seen everywhere you look. The sales volume of purely electric cars (BEV – battery electric vehicle) rose by 60 percent in the past year. 2018 could be the first year that the one-million mark for newly registered electric cars is reached. These figures are set to skyrocket again from 2020, the year that Volkswagen will launch the first models from the new ID. family on the market: the compact ID. and, a short while later, the ID. SUV – two zero-emission vehicles with the same range as today's petrol-driven cars. Thomas Ulbrich, Member of the Volkswagen Brand Board of Management, E-Mobility division: "As early as 2020 we intend to sell 150,000 e-cars, of which 100,000 will be the ID. and ID. SUV. Speeding up the shift to e-mobility will help us to meet the extremely ambitious CO_2 targets that have been set in Europe, China and the USA." By 2025 the sales volume of cars from the ID. family fleet is expected to increase to a million each year.

Affordable electric mobility

Globally, more than six million new Volkswagen vehicles roll out of production plants and onto the road each year. The brand makes technical innovations affordable for many car drivers. And exactly this same rationale will apply to all future electric vehicles in the new ID. family: Volkswagen's aim is to make electric cars attractive to as many people as possible, thus paving the way for the breakthrough of electric mobility. "The ID. will prove to be a milestone in terms of technological development. It will be the first fully interconnected electric vehicle that is 100% suitable for day-to-day use, and millions of people will be able to afford it," says Christian Senger, Head of the Volkswagen E-Mobility product line.

Platform strategy as a factor for success

The technological backbone of the ID. family is a newly developed vehicle platform: the modular electric drive matrix or MEB for short. Volkswagen is one of the most successful platform developers in the automotive industry. One example of this is the modular transverse matrix (MQB), probably the most successful vehicle architecture in use at present: around 55 million vehicles are being produced by the Group based on the first generation of MQB. Volkswagen is now applying this same platform strategy to the era of electric vehicles. The MEB is not just the technical matrix for all models in the Volkswagen ID. family, but for many electric cars produced by other Group brands, including Audi, SEAT, Škoda and Volkswagen Commercial Vehicles.

Electric without compromise

The MEB has two major unique selling propositions. First, it is not a platform for vehicles with combustion engines that has been retroactively modified. Instead it is a modular assembly matrix designed specifically for purely electric cars, which enables Volkswagen to utilise this technology to maximum effect. Christian Senger: "The MEB redefines the vehicle architecture and achieves a significant improvement in the sense of spaciousness. What's more, all models of the ID. family will be quick charging." Second, the vehicle concept and design can be structured in a more flexible way than ever before – the spectrum ranges from compact cars to SUVs and MPVs. Thanks to a 'Design for manufacturing' the MEB is also suitable for speedy and efficient production. This will enable the Group to achieve economies of scale, thereby making electric cars cheaper and more affordable for many people. Thomas Ulbrich adds: "The MEB modular electric drive matrix is probably the most important project in Volkswagen's history, similar to the transition

from the Beetle to the Golf. It forms the basis for more than 10 million electric cars across the Group during the first wave and is paving the way for electric mobility."

Four ID. models have already been revealed as prototypes

With the I.D., the I.D. CROZZ, the I.D. BUZZ and the I.D. VIZZION, Volkswagen has already presented four ID. models as prototypes. The development of the vehicle technology is virtually complete, as are the designs of the various models. Contracts with the battery suppliers have been signed. And Volkswagen is investing more than one billion euros to prepare its plant in Zwickau for the production of MEB vehicles. The company is also committing itself to developing a comprehensive charging infrastructure. In short: Volkswagen's e-mobility offensive is taking shape on all fronts. The company's vision: ELECTRIC FOR ALL!

Key aspects

MEB architecture

The countdown to the ID. has started.

Volkswagen will launch a newly developed generation of electric vehicles onto the market from 2020 in the shape of the progressive, avant-garde ID. family. It will include different zero-emission vehicle classes, whose range is broadly similar to today's petrol cars. The ID. – an affordable, four-door, fully interconnected compact car – will be the first model in the ID. family to be released in 2020. Volkswagen unveiled a prototype of the I.D. at the Paris Motor Show in September 2016. Twenty-four months later, this purely electric Volkswagen – which has an impressive top speed – is now set to enter series production.

Without compromises

The new ID. will be the world's first model based on the modular electric drive matrix to be released onto the world market. The MEB is the technical element that will link all future models in the ID. family: a platform specifically developed for purely electric vehicles. The components in the electric drive system and the package are therefore consistently interlinked. Offering a range on the level of today's petrol-driven vehicles and available for the same price as a diesel car, the ID. also has the potential to facilitate the breakthrough of environmentally friendly electric mobility and usher in a new era of electric drive systems.

Large wheelbase, small overhangs

This enables Volkswagen to use the design specifications of the MEB to enhance the range, space, versatility, comfort and dynamics of all models. These benefits will result in an entirely new form of mobility for drivers and

passengers. The fact is that the interior dimensions and versatility of the ID. will exceed all current limits in its class. Just as revolutionary is the ratio of the extremely large wheelbases to the overall length, and the thus resulting short overhangs. This is possible because there is no need for a combustion engine in the front, and the axles can thus be transferred far toward the outside.

All components of the MEB drive matrix in detail

The zero-emission drive in the ID. primarily consists of an electric motor integrated into the rear axle together with power electronics and a gearbox, a high-voltage flat battery installed in the vehicle floor to save space and auxiliary powertrains integrated into the front end of the vehicle. The power electronics are effectively a link that controls the flow of high-voltage energy between the motor and the battery. The power electronics convert the direct current (DC) stored in the battery into alternating current (AC). Meanwhile, a DC/DC converter supplies the onboard electronics with 12 V of power. The 1-speed gearbox transfers the power from the motor to the rear axle. The motor, power electronics and gearbox form a single, compact unit. The electric motor of the I.D. concept car showcased in 2016 at the Mondial de l'Automobile in Paris has a power output of 125 kW / 170 PS. The I.D. prototype can accelerate from 0 to 100 km/h in under eight seconds, with a top speed of 160 km/h. Electric drive motors offering either more or less power may be considered for the 2020 series version. In parallel to this, the idea is to be able to configure the ID. using different sizes of battery. This will enable the drive to be precisely attuned to how that specific car is to be used – as is standard for petrol and diesel engines. The battery's modular layout allows scalable ranges from about 330 up to more than 550 kilometers (WLTP / Worldwide Harmonized Light Vehicles Test Procedure).

Ideal weight distribution

The battery is the decisive factor when it comes to the ID.'s range. It is installed in the underbody, wich saves space and significantly lowers the centre of gravity. The location of the battery in the centre of the vehicle results in optimal weight distribution of close to 50:50. The low centre of gravity and the balanced weight distribution lead to a driving behaviour that is dynamic as well as balanced.

Update-compatible hardware and software

The MEB will enable new assistance, comfort, infotainment, control and display systems to be integrated into vehicles across the board. The I.D. prototype presented at the Paris Motor Show, for example, featured an AR (augmented reality) head-up display which projects information such as visual cues from the navigation system into the virtual space in front of the vehicle. Without the new platform, this technology would not be able to be integrated. To control the huge range of features on board the ID. models, Volkswagen has designed the completely new end-to-end electronics architecture, called E^3, as well as a new operating system, called vw.OS (OS = operating system). The ID. will be the first to make full use of "E^3" and "vw.OS". The new E^3 end-to-end electronics architecture consolidates the control units known across the industry today to create a much more powerful and centralised processor unit. And the performance and technological desirability of the models is not just guaranteed when the vehicles are new; Volkswagen will work to ensure enduring appeal across the vehicle's entire life cycle by making the systems compatible for updates and upgrades accessed via the Cloud.

ID. family is always on

The models in the ID. family are always online and can access a range of information and services, some of which are entirely new. Volkswagen is therefore set to transform from a pure vehicle manufacturer into a mobility provider of vehicles and services characterised by extensive digitalisation. During this transformation process, the focus will be on electric mobility, connectivity (linking the vehicles with the users and the internet) and – from 2025 onwards – automated driving.

One chassis, many body versions

The range of MEB models will be just as large as the current crop of MQB vehicles. At present, MQB is used as the basis for models ranging from the Polo and the upcoming T-Cross to the seven-seater Atlas US SUV. For the ID., the MEB programme will start one class higher. As with the MQB, the large models with up to seven seats will be at the forefront when it comes to deploying the modular electric drive matrix worldwide. A zero-emission SUV in the style of the I.D. concept vehicle CROZZ will be launched in 2020, the same year of release as the compact ID. The concept car I.D. BUZZ in the meantime shows the path for a zero-emission MPV from Volkswagen, which, with its design, follows the DNA of the legendary Bulli (USA: Micro-bus) and which will come onto the market as a series version in 2022. The avant-garde I.D. VIZZION opens a window into the future of the saloon. A standard counterpart for the saloon is expected in 2022. Other Group brands belonging to Volkswagen AG will also take advantage of the MEB.

Two product directions from 2020

The ID. family is Volkswagen's attempt to shift the paradigm of its model policy. Here's why: as one of the first producers, Volkswagen will offer conventionally powered vehicles such as the Polo, Golf, T-Roc, Passat, Tiguan and Arteon alongside pure electric-powered models such as the ID. on a standalone basis. In contrast to other strategies based on multi-traction drive kits – a platform with both conventional and purely electric drive systems – the fork in the product lines will result in various benefits for customers. The MEB – designed with purely electric drive systems in mind – enables the size of a vehicle's wheelbase to be increased while reducing the body overhangs; resulting in more dynamic proportions. The designers used this as their basis to create a standalone design DNA for the new zero-emission vehicles. As outlined above, increasing the size of the wheelbase will lead to much larger and more versatile vehicle interiors.

ELECTRIC FOR ALL

The ID. and ID. SUV are already assuming a key function in the breakthrough of electromobility with the annual quantity of around 100,000 newly registered vehicles planned for 2020. Volkswagen will then be able to introduce the zero-emission vehicle to new sales regions, thereby helping to ensure that this new drive type finally achieves its breakthrough. In parallel to the ID. and ID. SUV's final development phase, Volkswagen will be launching its new ELECTRIC FOR ALL public relations campaign in autumn 2018. This claim is a promise to make electric mobility accessible to more people than ever before. The ID. models will set a new milestone and follow in the footsteps of the legendary Beetle and Golf, two models with which Volkswagen wrote its own history in the 1950s and 1970s.

Battery technology

The battery is the decisive drive component

The battery system of an electric vehicle must meet the highest requirements and not solely in terms of achieving the best possible energy yield over long distances. Drivers also expect that the costs for the batteries will fall, that the operating life will be extended and that suitability for everyday use will be guaranteed in all operating conditions and temperatures. Moreover, they want the charging time for the cells to be as short as possible. The batteries in the ID. family will comply with all of these parameters.

Volkswagen Group Components supplies batteries and drives

The largest automotive manufacturer in Germany is now applying its extensive experience from decades of development, production and scaling of engines and gearboxes. This know-how has been used in the last few years for the fully electric models (BEV / battery electric vehicle) and plug-in hybrid vehicles (PHEV). The current model range includes the e-up![1] and e-Golf[2] zero-emission vehicles and the Golf GTE[3], Passat GTE[4] and Passat Variant GTE[5] plug-in hybrid models. Each of these is equipped with high-voltage batteries that are reliable and extremely safe. They have an energy yield of between 8.7 kWh (Golf GTE[3]) and 35.8 kWh (e-Golf[2]). These batteries are primarily produced at the Volkswagen component plant in Braunschweig. Volkswagen Components, the business unit responsible for the drive systems, and which will be a standalone unit from January 2019, is currently expanding the Braunschweig site so as to be able to build up to half a million battery systems per year in the future. Volkswagen will thus be able to guarantee its supply of batteries. In addition, a pilot line for battery cell production is currently being built in the Salzgitter factory. The Volkswagen Components business unit also produces the electric drives – its plant in Kassel has been restructured for this purpose. Against this backdrop, Volkswagen

is investing 1.3 billion euros in electric mobility at its sites in Braunschweig, Salzgitter and Kassel alone.

The battery system is integrated into the MEB

The Volkswagen Components business unit has developed a completely new, less complicated but significantly more powerful battery system for the Volkswagen ID. family. Unlike the batteries used up to now, the MEB system has the benefit of being scalable, which means it is relatively simple to integrate it in different performance levels into the ID. models. For example, if the owner of an ID. is less interested in having a car that can travel great distances – because they primarily use it in the city and only travel short distances – they can opt for a battery with a lower energy yield. This makes the vehicle cheaper. Drivers who frequently drive for longer stretches would be more likely to opt for a larger battery. This gives the vehicle owner more flexibility. It is exactly this ability to customise performance that makes the new battery system so attractive. Among the further advantages are weight optimisation (thanks to an aluminium housing), the adaptability of various cell types, as well as integrated cooling. The battery can thus be used for the drive on one axle, or on both axles. As the cell modules are arranged in a similar manner to a bar of chocolate, the batteries are also easy to install. Volkswagen has also been able to increase the charging capacity to up to 125 kW – a value so far not realised in the segment of the ID., which will accelerate charging and thus shorten the charging stop.

A detailed overview of the battery components

The MEB batteries are built as follows: the bottom layer provides solid buffer protection. Placed on top is the aluminium battery housing with a crash frame, integrated battery cooling and a connection box for the high-voltage and low-voltage electrical system (AC, DC and 12 V). The newly de-

veloped MEB cell modules, which consist of individual battery cells, are installed in the battery housing. The cell controllers (CMCe) – control units to monitor the cells (voltage, currents and temperature) and cell balancing (ensuring the cells are uniformly used in day-to-day operation) – are integrated in the longitudinal beam of the battery housing. The battery electronics unit (BMCe) is integrated in the rear part of the battery system as a further control unit. Cell module connectors are used to link the cell modules to one another; meanwhile, measuring cables communicate with the battery electronics. The battery housing is closed at the top with a cover that is easy to remove in the event that maintenance is required.

All relevant cell types

Both the pouch and prismatic versions can be used as cell types, resulting in high flexibility in collaboration with cell suppliers. Volkswagen achieves the highest possible energy density by exploiting the packing density in the cell modules to the maximum. The energy density and energy yield of the batteries will continue to increase over the coming years. The use of solid-state batteries may result in another breakthrough in the second half of the next decade.

Centre of Excellence

Volkswagen incorporated the development of lithium-ion batteries into a Centre of Excellence for battery cells in 2017. Cell suppliers receive detailed specifications on the product from the Centre of Excellence for battery cells. The Centre of Excellence is therefore responsible for all battery cells used by the Volkswagen Group.

How the battery cells function

A lithium-ion battery cell consists of an anode (carbon, copper foil), a separator (porous polyolefin film, ceramic-coated), a cathode (lithium metal oxide, aluminium film) and an electrolyte (organic solvent, lithium conducting salt, additives). When charging, the lithium ions migrate from the cathode to the anode and are stored there. Electrical energy – supplied by the electrical grid – is then converted into chemical energy. The electrons flow through the electrical circuit while the lithium ions flow through the separator. During the discharge process – to operate the electric motor – the lithium ions migrate back to the cathode. The chemical energy is then converted into electrical energy once more. In this case, the electrons flow through the electrical circuit and the lithium ions flow through the separator in the opposite direction.

Charging infrastructure

The overall concept is decisive

The breakthrough for e-mobility is determined by the factors of price, range and charging infrastructure. This is exactly where the new ID. scores. It will offer an excellent price-service ratio and range. Charging an ID. is as simple and as self-explanatory as connecting a smartphone to a power source at the end of the day. The fact is that having to drive to the "power charging station" or even make a detour will be the exception rather than the rule in the future. Still, to ensure that charging is fast, simple and easy, all the relevant parameters must work together: the vehicle, the mobility services, and the infrastructure. For Volkswagen, e-mobility is thus more than just a good e-car; the overall concept is decisive. Therefore, the Volkswagen brand is building its own charging and energy ecosystem in the form of hardware and software for the vehicles' entire environment. Against this backdrop, Volkswagen is engaged in all areas of use: at home, at work, in the public realm, and on the motorway. As many activities as possible are thus bundled in-house in order to ensure the quality of all services.

Charging at home

According to current surveys, most ID. drivers will only have to charge their car once a week, as the majority of commuters do not travel further than 50 kilometres per day. Based on analyses by Volkswagen, it is estimated that around 50 percent of all charging processes will take place at home and another 20 percent will take place at work. Volkswagen will thus offer a modular programme of wall boxes which can be mounted in carports, garages or company car parks. While a vehicle is charged at 2.3 kW via the standard 230 V grid, the wall box will allow the ID. and other models to be charged at a rate of up to 11 kW (AC) – this charging capacity is sufficient to fully charge the Volkswagen's battery overnight (which is often cheaper) or during the

working day. The starting price for the Volkswagen wall boxes will be around 300 euros plus installation costs. Volkswagen also plans to produce wall boxes that offer 22 kW (DC) charging capacity and work in a bidirectional manner, i.e. also allowing energy to be supplied to the grid. At night (at times of low energy consumption in private households and businesses), electric vehicles connected to the bidirectional wall boxes will also serve as a storage battery for surplus capacity.

Charging on the go

25 percent of charging processes will take place at public quick-charge stations, while 5 percent will occur on motorways – in both cases at a rate of more than 125 kW. It will be enough to charge once for a 700-kilometre-long stretch. If the ID. is charged at a quick-charging station with the aforementioned 125 kW power, charging will be completed in around 30 minutes.

Ionity joint venture

Expansion of the charging infrastructure is of utmost importance. One relevant component in achieving this goal is the Ionity joint venture. Through Ionity, Volkswagen is cooperating with the BMW Group, Daimler AG and the Ford Motor Company to create a reliable network of extremely powerful quick-charging stations along European motorways. A total of 400 quick-charging stations, dubbed the 'filling stations of the future', should enter into operation by 2020. The ID. models will be able to charge batteries at these charging points with a power of up to 125 kW.

Overall, it is critical that the expansion of the charging infrastructure must be massively pushed in all countries. It goes without saying that Volkswagen is contributing to the expansion of the charging infrastructure: All 4,000 au-

thorised Volkswagen dealers in Europe will be equipped with on-site charging stations. Quick-charging stations with up to 150 kW power will also be installed at the Volkswagen charging points. In parallel to this, Volkswagen will expand the network of charging stations at its production sites in employee car parks from 1,000 to 5,000 by 2020. What is more, Volkswagen is also doing its utmost to provide regeneratively generated power at the company charging points wherever possible.

In the future, payment can be made without cards

The "We Charge" online service that will be offered by the Volkswagen mobility platform "WE" in the future is another indication that Volkswagen is transitioning from a pure vehicle manufacturer to a fully fledged mobility service provider. The app-controlled service answers all your questions about charging – Where can I charge? How long will it take? How much will it cost? How can I pay? – with practical answers and solutions. "We Charge" manages the "Planning & Finding" and the "Charging & Paying". The smart online service shows the most suitable charging point, reserves it, and navigates to it. In this way, "We Charge" eases the fear of the e-car running out of power by providing access to the charging network with the highest density across Europe. With flexible charging agreements and a transparent billing system. All thanks to Volkswagen's shareholding in Hubject – eRoaming, a platform which makes it possible to charge electric vehicles throughout Europe no matter who the provider is. With 300 partners, 55,000 charging points, as well as a comfortable authorisation and billing. Payments are currently made via RFID (Radio Frequency Identification) or smartphone app (with the QR code). In the not too distant future the system will be revolutionised with "Plug & Charge", which uses block-chain technology to facilitate billing and payment for the charging process directly via the ID. itself. The ID. family models effectively become driving credit cards.

The ID. family as part of the power grid

The future of e-mobility provides several other smart solutions: Integrated into the home power network, zero-emissions vehicles will stabilise the power grid as so-called smart-grid solutions by storing surplus capacity in the power network, which frequently accrue at night and so far remain unused. Volkswagen wants to go one step further than simply providing wall boxes: The company is also planning to design a digitally linked home energy management system (HEMS), which can be used to reduce energy costs for households and mobility alike and with which the ID. fleet will become a part of the power network. Behind HEMS are hidden intelligent computers that manage the energy demand of the e-car and the house heating pump while incorporating photovoltaics and household batteries. In the evening, the user will enter the range they require for the following day and at what time. The ID. now communicates with the HEMS and itself establishes the best charging cycle on the basis of the current electricity price and availability. And what is more, the HEMS can, for example, fall back on the available residual energy of the electric car to temporarily cover the power need of the home. All of this happens completely automatically.

Sufficient power is available

Even with a sudden increase in the number of newly registered electric vehicles, the available power will be sufficient. Take Germany as an example: one million electric vehicles would consume approximately. 2.4 TWh (2,400,000,000 kWh) of power per year. Annual energy consumption in Germany is 517 TWh. Thus energy consumption will only rise by 0.5 percent due to the use of electric cars. When charged overnight, this value is rationalised again due to the use of surplus capacity. It should also be noted that an electric car is extremely efficient. It can travel four times further than a diesel car based on the same energy consumption rate. Volkswagen has also calculated that, over its lifespan, the e-car has the best CO_2 balance of all

drive types; the figures have been certified by TÜV. In the mid- and long-term, this advantage will increase because more and more power is being fed into the grid from renewable sources.