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Volkswagen

The new e-up!

Wolfsburg, September 2013

Note:

You will find this press information and images of the e-up! on the Internet at: **www.volkswagen-media-services.com**. User name: **wobvweup** | Password: **09pr2013**

Equipment details and technical data apply to the model range sold in Germany. Details for other countries may vary.

Contents

Zero emissions by Volkswagen:
New e-up! is the most frugal of all battery electric cars

11.7 kWh of energy for € 3 to drive 100 km sets new standard of efficiency

Navigation and information system with e-specific software as standard

Wolfsburg, September 2013. From the middle of October Volkswagen will be supercharging its model range with an extremely efficient electric vehicle – the new e-up!. Creating a double impact on the e-mobility stage, the four-door city specialist will be followed just a few months later, in spring 2014, by a further zero-emissions Volkswagen: the e-Golf. Both electric cars will make their debuts at the International Motor Show (IAA) in Frankfurt (10th to 22nd September), heralding the era of full-production e-mobility for Volkswagen. Henceforth Volkswagen will thus be offering in its vehicles every form of drive system relevant in the world today.

e-up! – battery electric Volkswagen sets efficiency benchmarks with consumption of 11.7 kWh/100 km

› **Low 'fuel costs'**. The launch of the e-up! marks the introduction of a next generation electric vehicle that thanks to an armada of innovative detailed solutions uses energy extremely economically. The e-up! consumes, for instance, just 11.7 kWh/100 km. It is thus the efficiency world champion. At an average electricity price of 25.8 cents (Germany, 2013), driving 100 kilometres costs just € 3.02.

› **Great efficiency**. The pioneering efficiency of the e-up! is attributable to the very good c_w value for a car of this size of 0.308 (4 per cent lower than the take up!), optimised roll resistance (7 per cent lower), the generally energy-saving drive system components, the highly effective regenerative braking system, innovative equipment modules and a newly developed, particularly efficient air-conditioning system.

› **Innovative engineering**. A compact electric motor (60 kW / 82 PS), the lithium-ion battery integrated into the floor between the axles and the power electronics form the hub of the new high-tech car's drive system. The electric motor's power is transferred to the front wheels via a single-speed gearbox.

› **Up to 160 kilometres**. Delivering 60 kW / 82 PS and with a top speed of 130 km/h, the e-up! has a range, dependent on driving style and payload, of between 120 and 160 km; at very low outdoor temperatures the range may lie below these values. This range works especially well in urban areas and for the majority of commuters. In Germany, for example, research by the Federal Ministry of Transport, Building and Urban Development found that around 80 per cent of all car drivers in the country, from commuters to motorists making lots of journeys, drive less than 50 kilometres a day.

› **Two economy profiles: 'Eco' and 'Eco+'**. The range of the e-up! can be varied via three different driving style profiles: the standard mode (automatically on), 'Eco' and 'Eco+'. Anyone nipping around travelling short distances, will stay in standard mode. For drivers wanting to extend the range, the first option is the 'Eco' mode. The effects of selecting this mode include paring back the e-vehicle's maximum power output to 50 kW. In parallel with that the electronics reduce the output of the air-conditioning system and modify the response curve of the accelerator pedal. In 'Eco+' mode the electronics limit maximum power output to 40 kW, modify the performance response curve and disable the air conditioning. In the 'Eco' and 'Eco+' modes the top speed is also reduced.

› **Regenerative braking in D1, D2, D3 and B**. Over and above the driving style modes the range of the e-up! can be influenced via the regenerative braking function. There are no fewer than five levels available: 'D' (regeneration only when using the brake), 'D1', 'D2', 'D3' and 'B'. In an electric car this number of levels leads to a different way of driving. By means of regenerative braking drivers can appreciably slow down the e-up! by lifting their foot off the accelerator. Used in an anticipatory way, regenerative braking thus replaces use of the brake pedal in many situations. At levels 'D2', 'D3' and 'B', the deceleration via regenerative braking is so strong that in this case the brake lights automatically come on. If the battery is fully charged, no regenerative braking occurs.

› **Great agility**. After 4.9 seconds the e-up! is going at a speed of 60 km/h; within 12.4 seconds it's 100 km/h. In 10.5 seconds it accelerates from 80 to 120 km/h. Top speed is 130 km/h. By way of comparison: the most powerful conventional e-up! (with 55 kW / 75 PS) accelerates from 0 to 100 km/h in 13.2 seconds and from 80 to 120 km/h in fourth gear in15.5 seconds. The comparison shows that the e-up! simply blows away prejudiced views about the performance of electric cars and makes a very strong case for itself as the ideal vehicle for inner-city motoring.

› **Battery in the vehicle floor**. The e-up! weighs 1,139 kg. Some 230 kg of that is accounted for by the lithium-ion battery. The fact that this battery lies flat within the floor of the car greatly lowers its centre of gravity and, especially in combination with the high starting torque of 210 newton metres, makes the handling feel extremely agile.

› **Plugs, wall box and charging stations**. To recharge the e-up! you simply connect it to the mains. There are various ways that this is done: the simplest option is to plug the mains charging cable supplied with the car into a conventional 230-volt socket. The battery is then charged from the mains at a power level of 2.3 kW. If completely flat, it is fully recharged in this way within around nine hours. As an option Volkswagen offers via its partners a wall box for the garage or car port that charges the battery at a power level of 3.6 kW. The (completely flat) battery would thus be 100 per cent recharged again after six hours. There are also public charging stations that 'refuel' electric cars at a power level of 3.6 kW. As a first, the e-up! can also be prepared for the combined charging system (CCS) using a DC power supply. In this case it can be charged via special charging stations at power levels of up to 40 kW. The battery is then 80 per cent recharged after just 30 minutes.

› **Exclusive features**. Volkswagen has developed a range of features and design elements specifically for the e-up! that make the electric car very quickly identifiable as such. The array of bespoke features includes the LED daytime running light's new signature look, aerodynamically developed alloy wheels and an interior in a bright and friendly design. The standard e-up! equipment also includes applications for the maps + more infotainment/navigation system programmed specifically for e-mobility, a radio/CD system, hands-free phone function, four doors, heated windscreen, air conditioning and heated seats. In Germany the new e-up! will go on sale at a base price of € 26,900 – no meagre amount of money for a small car, but a manageable sum for a four-seat, four-door, multifaceted and extremely well appointed high-tech electric car with a highly innovative drive system.

WORLD

e-mobility – en route into the future Volkswagen is pursuing a powertrain and fuel strategy with a long-term approach

› **Market leader by 2018**. Volkswagen defined its roadmap into the future and thus also the starting point for electric vehicles such as the e-up! and e-Golf by producing a power-train and fuel strategy that takes an appropriately long-term view. This strategy assigns realistic timeframes to the introduction of new, alternative drive systems, such as hybrid, electric and hydrogen. In addition, Volkswagen has made it the company's aim to establish the brand as market leader in e-mobility (as in other areas) by 2018.

› **2013 is a key year for electric mobility**. Nevertheless, Volkswagen will in future not be putting its weight behind e-mobility alone but will be pushing forward with an intelligent mix of the most efficient drive systems. In this respect battery electric systems – as the new e-up! and the e-Golf will show – are a sensible and essential addition. The reasons for this are obvious: first, electric vehicles enable large-scale utilisation of renewable energy sources (wind, solar, hydro) to power automobiles. For example, when it launches the smaller e-up! in Germany this autumn, Volkswagen will be offering the ideal electrical power for the car ("BluePower"). This energy, generated without

releasing CO_2, comes exclusively from hydro-electric generating plants in Germany, Austria and Switzerland. Supply and sales partners are the German company LichtBlick SE and the Volkswagen Bank. Electric cars also offer emissions relief to metropolitan areas based on their drive technology which always features zero local emissions. Furthermore the new electric vehicles from Volkswagen are also a genuine alternative through the fact that in terms of efficiency and recycling their battery technology is for the first time fully compatible with the requirements of high volume production. All drive system factors are thus now perfectly set for e-mobility to really take off.

› **Mobility to match drivers' needs**. It is clear that electric cars geared to shorter journeys can no more replace vehicles designed for long distances than a sports car can replace a people-mover. And yet they all have their purpose and justification: electric cars are the specialists for the cleanest and quietest style of urban motoring, while the different hybrid drive systems and conventional engines are the masters of long distances. Within the framework of the company's powertrain and fuel strategy Volkswagen will therefore, as mentioned above, be pushing forward in parallel with the introduction of new hybrid models. In this regard the Jetta Hybrid BlueMotion and the Touareg Hybrid BlueMotion are already in the model range. The next model of this kind due to follow next year is a Golf plug-in hybrid, which in contrast to the standard hybrid can also cover longer distances

(50 kilometres) solely on electric power thanks to a battery (with greater capacity) that can be charged from an external power source. Volkswagen will in addition continue to enhance its efficient petrol, diesel and gas engines (TDI, TSI, TGI), as these drive technologies will coexist long into the future. It is also the case that all new Volkswagen models based on the Modular Transverse Matrix are designed in such a way that they can be fitted with any one of the different types of drive system.

› **In time with big city life**. The fact is that the target group for electric cars is growing, as a paradigm change has begun. A core focus of social behaviour is increasingly on sustainable mobility. However the products for putting this environmental awareness into action need to be suitable and enjoyable. Like an e-up!, which accelerates from standstill up to the tempo of big city life in well under five seconds (0–60 km/h: 4.9 seconds). The new Volkswagen therefore has the potential to charge the electric car segment with innovative engineering, great everyday practicality and a dynamic feeling.

Gliding silently with high torque:

The e-up! has an addictive edge – ‘driving joy with no emissions’

With a fuel consumption value of 11.7 kWh/100 km, the e-up! is the world champion of efficiency

e-up! and smartphone bring together information and mobility

Wolfsburg, September 2013. The new e-up! is first and foremost a Volkswagen. And that means that like all other versions of this specialist city car the electrically powered version is also fully intuitive to drive, reliable and extremely safe. A few things, of course, are different, including how it is driven. First off: electric vehicles always have automatic transmission – with one forward and one reverse gear.

Ready to drive

Clear to go. Everything begins as it always begins. Get in, buckle up, foot on the brake, start the motor. In cars with internal combustion you now hear the engine, while the rev counter's needle also shows that things are happening. In the e-up! nothing like that occurs. Although the electric motor is indeed on, it produces neither noise nor vibrations. And as for the rev counter, there is none. The e-up! signals its readiness to its driver via routines specially designed for the purpose. When the car is started and ready to go, the speedometer needle rotates once as far as it will go and then returns to the home position. The illumination of the indicators on the e-up! instrument panel is also switched on, regardless of whether the car's outside lights are on or not. At the same time the battery charge indicator rotates to the current level and the power indicator moves from 'Off' to '0'. Last but not least, the word 'Ready' appears in the panel's central display, backed up by an audible signal – the zero-emissions journey can now begin.

maps + more

Range display. The e-up! comes as standard with the portable maps + more navigation system, complete with Bluetooth hands-free facility. In the e-up! it provides numerous new functions, such as range display (‘360° range’). In this mode a map of the surrounding region shows the radius of the area that can be reached with the current level of charge. Here too there are several different functions: ‘One-way range’ (route in one direction), ‘Range including return’ (route there and back) and ‘Combined’ (both range options).

Charging stations via POI. Whenever a destination is entered into the navigation system the driver is informed (via a newly devised range warning system) whether the distance is possible with the current level of battery charge; if not, appropriate stops can be scheduled via the charging stations shown in the points of interest (POIs). A single, one-way route thus becomes a multi-stop route. Drivers are also able to save their own and new charging stations on the system and thus integrate these into their route planning.

Cleverly managed. Among the other maps + more functions and displays specific to the e-up! are the power flow and regenerative braking display and an e-manager. Using the e-manager, drivers can pre-programme the charge start time and climate control pre-conditioning (switching on the parking heater in winter or parking ventilation in summer for up to 30 minutes; if not plugged into a charger for up to 10 minutes). The advantage of having the car’s interior warmed up or cooled down while the battery is being charged (apart from the added comfort) is that you do not affect the battery’s charge level by any initial heating or cooling before starting up. As a result the battery’s full range is available to you as you start your journey.

Volkswagen Car-Net e-Remote

App for the e-up!. Using the ‘Car-Net e-Remote’ app it is also possible to make the most of these settings and information requests via a smartphone or the Car-Net website. In detail the app contains the following functions:

› **Programming of the departure time** – Functions scheduled according to the departure time include the park heater/ventilation function; it is started at a specific time that depends on the outdoor temperature, so that the desired interior temperature is reached by the programmed departure time.

CITY

› **Climate control** – Starting and stopping the parking heater/ventilation function, plus display of the outside temperature and the target temperature for the car's interior. As outlined above, the heating or ventilation is done via stationary climate adjustment during the charging process without putting any drain on the battery. And that extends the range.

› **Charging the battery** – Starting and stopping the charging process, indicating charger connection status, charge status, charge progress, charge level, charge start time and range;

› **Accessing vehicle data** – Information display relating to individual journeys (single trips or long term), such as kilometres driven, journey time, electric motor power consumption, power consumption of other consumers such as air conditioning and radio, use of regenerative braking;

› **Vehicle status queries** – Doors and boot locked, lights (on/off), charging cable plugged in, position where the e-up! was last parked (GPS position on a map).

One year free. With the purchase of an e-up! the online service is included free for a year. Any paid-for extension thereafter is optional. The Volkswagen 'Car-Net e-Remote' app will be available

from the time of the e-up! launch. It is available for the iPhone and the Android operating system. All services will also be available to registered customers online on the same terms. The link to the app: **www.volkswagen.com/car-net**.

Range

A question of style. The other specific functions of the e-up! used while driving the car are practically self-explanatory. You have to think of the car's 'tank' as a battery filled with electrical power that empties during the journey. The faster you drive or the more you accelerate, the greater the amount of power consumed. However, as the driver you have considerable influence over this level of consumption and thus over the range. The e-up! is able to switch off temporarily unneeded consumers and in general to transform kinetic energy – produced when coasting or by braking – into electrical energy and to store it in the battery.

Two economy profiles: 'Eco' and 'Eco+'. The range and power economy of the e-up! can be varied in several ways. For one via three different driving style profiles: standard mode (automatically on), 'Eco' and 'Eco+' (activated via buttons in front of the automatic transmission's gear lever knob). Anyone nipping around travelling short distances, will stay in standard mode.

› **Eco**. For drivers wanting to extend the range, the first option is the 'Eco' mode. In this case the e-motor's maximum power output is pared back from 60 to 50 kW and pull-away torque reduced from 210 to 167 Nm. In parallel the electronics reduce the power of the air conditioning and modify the accelerator pedal response curve (as the driver pushes down on it, the power is called off in a flatter curve). Acceleration (0–100 km/h) extends as a consequence from 12.4 to 15.0 seconds; top speed drops from 130 to 115 km/h.

› **Eco+**. In 'Eco+' mode the e-up! uses the battery's power extremely economically. Maximum output now gets reduced to 40 kW and pull-away torque to 133 Nm. At the same time the electronics switch off the air conditioning and make the accelerator pedal response curve even flatter. Top speed in 'Eco+' mode is 90 km/h, thus still allowing a relaxed driving style along country roads and in built-up areas.

Regenerative braking – D1, D2, D3 and B. As well as via the driving style modes, the range of the e-up! can be also influenced via the regenerative braking function. There are no fewer than five levels available: 'D' (regeneration only when using the brake), 'D1', D2', 'D3' and 'B'. The number of levels is in no way too much for the driver to handle – it leads instead in the e-up! to a new way

of driving, as regenerative braking can be used to slow the car down. Used in an anticipatory way, regenerative braking thus replaces use of the brake pedal in many situations. However, if the battery is fully charged, no energy regeneration takes place. In this case, the braking power also reduces, which the driver can feel intuitively. It works like this:

› **D**. The e-up! starts by default in the 'D' setting – in this setting there is deceleration kinetically induced through rolling resistance as soon as the driver's foot is taken off the accelerator ('coasting'), but no recovery of brake energy takes place. Whenever the driver 'steps off the power', though, or when the e-up! is going downhill it rolls perfectly. And that too reduces consumption. When the e-up! is slowed down fairly sharply via the hydraulic brake system it does, however, recover brake energy even in the 'D' setting.

› **D1, D2, D3**. If the traffic becomes more congested (especially therefore in urban areas) or the road becomes more winding, the regenerative braking settings are available to the driver. The regenerative and thus the braking intensity increases across the four levels: D1, D2, D3 and B. When regenerative braking is used the brake lights therefore automatically come on. For regenerative braking the electric motor changes into generator mode in order to be able to supply the recovered electrical power to the battery. In gear lever setting 'D' the driver simply taps the gear lever knob to the left to switch to 'D1' (1x), 'D2' (2x) or 'D3' (3x). Tapping the knob to the right moves down the D levels. If the gear lever is pushed to the right and briefly held there, the electronics switch in one jump back to 'D'.

› **B**. In order to utilise maximum deceleration (40 kW at 100 km/h) in the 'B' setting (B = Brake), the gear knob needs to be clicked backwards towards the handbrake. If the driver's foot is now taken off the accelerator pedal, he or she will feel the car slowing down as if the brake had been applied. In urban traffic with sufficient room ahead the car can be slowed to a standstill in this way. The fact is that drivers get used to the regenerative braking function very quickly and use it, above all in the 'B' setting, as a substitute for slowing down by applying the brake.

Volkswagen has developed specifically for the e-up! an electromechanical brake servo. This optimises the driver's braking force in the same way that brake servos do in conventional cars. In the case of the electromechanical brake servo, however, this happens via what is known as 'brake blending' – a process in which low levels of deceleration are produced solely through the e-motor's braking torque.

Stronger deceleration, meanwhile, is achieved through joint braking torque from the electric motor and the hydraulic brake system.

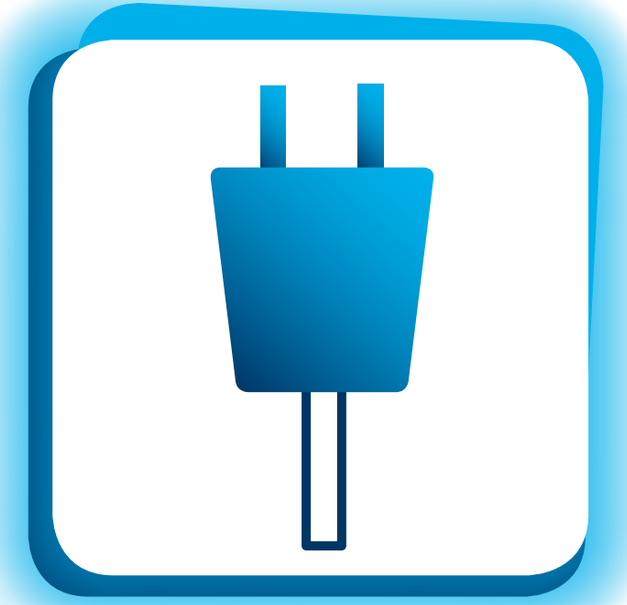
Handling and ride

Maximum torque. The e-up! is powered by a 60 kW/82 PS electric motor, which is installed at the front in the engine compartment. The motor delivers its maximum output at full acceleration; continuous output during steady driving is 40 kW/54 PS. Both output levels are available within a range of 2,800 to 12,000 rpm. It is meanwhile from a standing start (up to 2,800 rpm) that the motor delivers its maximum torque of 210 newton metres. The very high level of torque for a small car and, as mentioned above, the fact that it is available right from the off has a major influence on the driving experience, as the car 'feels' as though it is being powered by an engine with a large cubic capacity and much more power.

Performance. After 4.9 seconds the e-up! is going at a speed of 60 km/h; within 12.4 seconds it's 100 km/h. In 10.5 seconds it accelerates from 80 to 120 km/h. By way of comparison: the most powerful e-up! fitted with a conventional engine delivering 55 kW/75 PS accelerates from 0 to 100 km/h in 13.2 seconds; in relation to elasticity (80 to 120 km/h) the figure in fourth gear is 15.5 seconds. The comparison shows that the e-up! blows away prejudiced views about the performance of electric cars.

As quiet as a premium car. One totally new aspect of the e-up! is the level of background noise inside the car, as the e-motor, a 'permanently excited synchronous motor', works away almost in silence. The e-up! also has especially good sound insulation, while the aerodynamic honing of the car body further reduces wind noise.

Optimised handling. The e-up! weighs 1,139 kg; 230 kg of that is accounted for by the lithium-ion battery, which with its rating of 18.7 kWh provides the e-motor with power. The 'normal' up! with a petrol engine is already an agile car with easy handling. The fact, however, that the battery of the e-up! lies flat within the floor of the car – arranged in space-saving manner in the area of the (non-existent) central tunnel and beneath the front and back seats – lowers the car's centre of gravity and gives the handling around corners, especially in combination with the high level of peak torque, an even crisper feel.



Charging

Plugs, wall box and charging stations. It is a remarkable feeling at first that petrol stations are now just somewhere to check your tyres' air pressure or to top up the windscreen washer. At the end of the day, or sometimes during it as well, you simply plug the e-up! into the mains. That becomes almost as much second nature as plugging in your smartphone to recharge it at night. Albeit that with the e-up! there are several different ways in which you can recharge the high-voltage battery.

› **Mains socket**. The Volkswagen is equipped as standard with a mains charging cable, which you plug into a conventional domestic alternating current (AC) socket. If it is completely flat, the battery is then fully charged again within around nine hours.

› **Wall box.** Available from Volkswagen's partner as an optional extra for the garage or car port is a wall box, which charges the battery at a power level of 3.6 kW (rather than the lower level of 2.3 kW via a mains socket). Charged in this way the battery would be 100 per cent recharged after six hours – if it had previously been completely flat. Batteries that are not completely drained take less time to recharge.

› **Alternating current charging stations**. As via a wall box, there are also public charging stations that ‘refuel’ batteries at a power level of 3.6 kW. This is done using an optional cable for AC charging stations.

› **CCS charging stations**. As a new car the e-up! can also be prepared for the combined charging system (CCS) using a DC power supply. This option includes a CCS socket as the interface on the car (on the right in the area of the original fuel cap). In this case the battery gets recharged via CCS charging stations at a power level of up to 40 kW. The cable needed for this is part of the charging station. Using this option the battery is back to a charge level of 80 per cent after just 30 minutes.

Plug-in connections – clean and easy. Unlike refuelling with petrol, recharging the battery is a clean affair. Switch off the motor, connect the charging socket on the vehicle to a normal mains socket, a wall box or a charging station via the cable and you’re all done! The charging process starts automatically. Unlocking the e-up! via the central locking remote control terminates the charging process. Only then can the charging cable be pulled out. An LED to the side of the charging socket indicates the status of the charging process. In practice it will also be the ‘Volkswagen Car-Net e-Remote’ app, via which drivers check whether the e-up! is fully recharged – as the information will have been sent wirelessly from car to smartphone!

Motor, gearbox and high-voltage battery made by Volkswagen:
Drive systems are a Volkswagen core competence – including on the e-up!

Car’s new synchronous motor is one of the world’s most efficient

With new brake servo the e-up! makes maximum use of braking energy

Under the bonnet of the e-up!

Wolfsburg, September 2013. In the new e-up! the compact electric motor (60 kW / 82 PS), the lithium-ion battery integrated into the floor between the axles and the power electronics form the hub of the car's drive system. The electric motor's power is transferred to the front wheels via a single-speed gearbox. The gearbox and electric motor are both made at Volkswagen components plants.

Zero-emission efficiency. Locally – and in general with green electricity on board – the e-up! (categorised in efficiency class A+) produces no emissions. With average consumption of 11.7 kWh/100 km, the new e-up! is also the most energy-efficient electric car on the market. In the NEDC cycle, this thus produces a maximum range of between 120 and 160 km; the range may lie below these values in very cold outdoor temperatures. The pioneering efficiency of the e-up! is attributable in part to a cw value of 0.308 (very good for a car of this size and 4 per cent lower than that of the take up!) and to optimised roll resistance (7 per cent lower). Also playing their part are the generally energy-efficient drive system components and the numerous new equipment modules, which consume very little power. The new, innovative features include here the air conditioning's intelligent controls and the entire high-voltage system. With a kerb weight of 1,139 kg, the e-up! is also very light despite the battery.

Electric motor and gearbox

12,000 rpm. The electric motor produces a continuous output of 40 kW / 54 PS (2,800 to 12,000 rpm). The maximum output available (also at 2,800 to 12,000 rpm) is, as mentioned above, 60 kW / 82 PS. Straight from a standing start the motor delivers maximum pull-away torque of 210 Nm (up to 2,800 rpm).

Synchronous motor. To be precise the e-up! motor is a permanently excited synchronous motor (PSM) with a single-speed gearbox optimised for minimum friction. The drive unit was developed in close collaboration between the Technical Development Division in Wolfsburg and the development departments of the Volkswagen components factories in Kassel and Hanover. The stator (stationary electromagnet), the permanent magnet rotor and the gearbox are made at the Kassel plant, while the foundry at the Hanover plant provides the complex motor housing fitted with a cooling jacket.

Greater efficiency. During the development process the electric motor's efficiency was repeatedly optimised via diverse technical enhancements. For the start of full production of the e-up! Volkswagen has thus been able to achieve a level of efficiency that ranks as 'best in class'. In general the level of efficiency of electric motors is around 90 per cent and thus clearly above that of internal combustion engines. By virtue of the fact that the electric motor and the gearbox have been integrated with very high quality intermeshing inside a single housing unit, the drive system is also particularly quiet and compact. The gearbox itself has, as mentioned, a single fixed forwards gear. To go into reverse, the electric motor's polarity simply gets switched around. In other words, the motor revolves in the opposite direction. The driver selects, as usual, modes 'D' or 'R' and, of course, 'N' (neutral) or 'P' (park). Further components contained in the gearbox include, in addition to the differential, the motor shaft, which revolves at very high speed (12,000 rpm), and the mechanical parking brake, constructed in extraordinarily lightweight fashion.

Lithium-ion battery

204 cells in 17 modules. The lithium-ion battery fitted in the e-up! weighs 230 kg and is made up of 17 modules, each with 12 cells. These 204 cells add up to a rated voltage of 374 V and rated power of 18.7 kWh. At peak level the cells provide an effective power output of 75 kW and over a continual period 35 kW. The battery, which is 1,726 mm long, 1,132 mm wide and at its highest point 303 mm high, has been integrated, as already indicated, in space-saving fashion within the floor of the e-up!. Compared to other lithium-ion cells (e.g. from the field of consumer electronics), the battery system's cells are particularly resistant to heat and cold, meaning that no separate battery cooling or heating

is required. Like the electric motor and the gearbox, the battery system, battery electronics and the relevant control software were also developed in house at Volkswagen.

Power electronics

Energy flow interface. Another central element of the drive system is what is known as the power electronics. This complex module weighs 10.5 kg in the e-up! and, acting as the link, controls the flow of high-voltage power between the e-motor and the lithium-ion battery (depending on battery voltage between 296 and up to 418 V). In doing so the power electronics convert the direct current (DC) stored in the battery into alternating current (AC) and use this to drive the motor. Via a DC/AC converter it also supplies the vehicle power circuit with a voltage of 12 V. The modules of the power electronics (LE 2.3) used in the e-up! include the motor inverter control circuit board, the DC/DC converter, a DC link capacitor and a controller board.

Phase and traction cables. The power electronics module is connected to the e-motor via the sort of yellow-and-orange three-phase cable typical for electric vehicles. The connection to the lithium-ion battery is established via two traction cables.

Direct current becomes alternating current. In respect of the all-controlling power electronics a distinction has to be made between two fundamentally different modes in which the e-motor operates: motor mode (propulsion) and generator mode (regenerative braking). In motor mode the power electronics use high-power transistors to convert the direct current (DC) stored in the battery into three-phase alternating current (AC). In generator mode, meanwhile, the alternating current is rectified for charging the battery. In this scenario the power electronics are like a kind of valve that let the electrical current flow only towards the battery that is to be recharged. This maximum phase current of the power electronics is limited in the e-up! to 385 A.

High voltage becomes vehicle power circuit voltage. As mentioned above, the 2.5-kW DC/DC converter integrated into the power electronics is responsible for supplying the vehicle's 12-V power circuit and thus works like a transformer. The 12-V power circuit and the high-voltage circuit are completely separate from each other in the vehicle. Also included in the power electronics are the controller for running the management software and a CAN interface for communication with control devices. Last but not least, the power electronics module dampens the effects of any sudden loading of the drive system (for instance, at moments of sudden acceleration) by regulating the torque accordingly.

Electromechanical brake servo

A fusion of brake system and motor brake. Electric cars are essentially equipped with two brake systems independent of each other: on the one hand, as in conventional cars, a mechanical, hydraulically operated brake system is there to slow the car down. At the same time, however, the e-motor acts when recovering energy as a motor brake. These two types of braking now blend together in the e-up! thanks to the electromechanical brake servo.

The brake servo's task. Regardless of regeneration mode ('D1', 'D2', 'D3' or 'B'), when operating as a generator the electric motor generates a degree of braking torque on the wheels – dependent on its speed and the battery's temperature and charge level. The variable parameters – motor speed and battery status – lead to fluctuating levels of electric braking. These fluctuations need to be hydraulically compensated and the degree of deceleration matched in this way to the braking performance called for by the driver. The management of the brake system required for this is called brake blending and is achieved via the new electromechanical brake servo. Volkswagen has succeeded here in its primary aim of making maximum utilisation of the e-motor's potential to slow down the e-up! in order to increase its range.

Less wear on the brakes. As the majority of braking processes involve only minor or moderate deceleration and are therefore executed without any wear via the e- motor, the electric system helps to keep the 'normal' brakes in top condition longer.

e-up! is the new high-tech top model in the range:
LED daytime driving lights as visual insignia of e-mobility

Navigation and information system with e-specific software as standard

Car-Net e-Remote controls air conditioning and charging of parked e-up!

Wolfsburg, September 2013. Volkswagen has developed a range of features and design elements specifically for the e-up!. As a result the electric car is quickly identifiable as such. The quality and range of features correspond, insofar as they are comparable, with the range's highest specification, the high up!. In addition, however, the e-up! also includes rear doors, air conditioning, heated windscreen, maps + more and the Car-Net app as standard. Furthermore, as outlined at the start, numerous features have been specifically created for the e-up!. Examples include the LED daytime driving light's new signature look, bespoke alloy wheels, a very brightly designed interior (with beige trim for the bottom section of the dashboard, door panel inserts and centre console) and functions specifically programmed for the e-up! for the maps + more multimedia/navigation system, which comes fitted as standard.

Exterior

Four doors and LED daytime running lights. The e-up! is being sold as a four-door car. The city motoring specialist is 3,540 mm long, 1,645 mm wide (excluding wing mirrors) and 1,475 mm in height. A striking identifying feature at the front of the car is the curved arrangement of the LED daytime running lights within the bumper – their signature look will become the identifying feature of all Volkswagen electric cars. Also typical for the zero-emission vehicles: the VW logo on a blue

background. The top motor vent – a strip between the headlights and the VW badge – is completely enclosed on the e-up! by an elegant chrome bar. That is because narrow air intakes above and below the number plate are quite adequate for the drive system in the e-up!. Meanwhile, beneath the rear hatch curved reflectors create a stylistic link with the 'e-signature' of the LED daytime running lights at the front. A bright rim around the third brake light also forms one of the features specific to the e-up!. The electric car is furthermore fitted as standard with 15-inch alloys in the new 'Blade' design, tyres (dimensions 165/65) optimised for low rolling resistance, heat-absorbing windows in the back (heavily tinted to the rear of the B pillars) and skirt extensions in the vehicle body colour. Meanwhile, to the left of the rear hatch and beneath the door mirrors the wording 'e-up!' indicates the car's electrically powered status.

Six colours. The colours available for the e-up! are two plain colours, 'blue' and 'pure white', plus four metallic shades, 'light silver', 'dark silver', 'dark blue' and 'black pearl'.

Interior

Bright trim, blue seams. Within the spacious interior (four seats and 250 to 923 litres of luggage space) it is details such as the bespoke seat covers that underline the technically clear character of the e-up!. The seats are covered as standard with fabric in the middle and faux leather on the side supports. The pattern is called 'grid'. In each instance the seams are in 'e-blue'. The seat designs, which are also available in darker colours, are enhanced by the light-coloured trim for the bottom section of the dashboard, the door panel inserts and the centre console. The dash pad (the upper part of the dashboard) can be ordered in 'blue', 'pure white', 'dark silver' or 'black pearl'. The painted areas of the door panels, meanwhile, are always in the same colour as the car's exterior. The blue decorative seams around the leather steering wheel, the hand brake lever and the gear lever correspond to the basic colours.

High-tech features. Also part of the standard specification are features such as height adjustment for the driver's seat, a rear seatback that can be split 40:60 and folded down, chrome rims for numerous controls and instruments (speedometer, centre console panel, inside door handles and light switches), driver profile selection, automatic climate control (Climatronic), radio with CD player (incl. MP3) and 2 x 20-watt music output, maps + more (incl. mobile 5-inch touchscreen, Bluetooth smartphone interface and live services), Car-Net e-Remote (app for remote control and access to diverse vehicle functions and info), the multifunction display, heated front seats and windscreen, central locking and electric front windows.

Optional features

‘drive pack plus’ for added safety. The list of additional features for the e-up! is simple and short, as the zero-emission city motoring specialist is already equipped as standard with all key convenience, functional and safety features. The array of equipment provided with this innovative Volkswagen car can, however, be extended through the addition of optional extras such as ‘sound plus’ (loudspeakers in the back), ‘drive pack plus’ (cruise control, ParkPilot and City Emergency Braking), door tread plates in the front with ‘e-up!’ wording, floor mats with blue stitching, a panoramic tilt/slide sunroof, variable cargo floor, winter and all-year tyres and the CCS socket for fast charging (all depending on the market).

DRIVE

The e-up! facts in overview

BASE PRICE
› € 26,900 (Germany).

BATTERY
› 18.7 kWh.

BOOT
› 250 to 923 litres.

CHASSIS
› Front – axle with MacPherson-type struts and wishbones.
Rear – semi-independent suspension

CO_2 EMISSION
› Locally 0 g/km. Volkswagen recommends using green electricity.

COLOURS
› Single colour paintwork in ‘blue’ or ‘pure white’.
Metallic shades: ‘light silver’, ‘dark silver’, ‘dark blue’ or ‘black pearl’.

CONSUMPTION
› 11.7 kWh/100 km.

CW VALUE: 0.308; CW X A
› 0,644.

DESIGN
› Walter de Silva (group), Klaus Bischoff (brand).

DIMENSIONS
› 3,540 mm long, 1,645 mm wide (excl. wing mirrors), 1,910 mm wide (incl. wing mirrors), 1,477 mm in height, 2,420 mm wheelbase, 585 mm overhang at the front, 535 mm overhang at the back.

DRIVE SYSTEM
› Electric motor, front wheel drive.

DRIVER ASSISTANCE AND HANDLING SYSTEMS
› Electronic Stability Control (ESC) including ABS, braking assistance, anti-slip regulation, engine drag torque regulation, optional City Emergency Braking and ParkPilot (at the rear).

E-MOTOR
› max. 60 kW/82 PS.

EQUIPMENT LINE
› e-up!.

EUROPEAN LAUNCH
› Autumn 2013.

GEARBOX
› Mechanical single-speed gearbox.

INFOTAINMENT
› RCD 215, sound plus, portable infotainment device / maps + more with 5-inch touchscreen.

MISSION
› Zero emission conquers the mass production market.

NAME
› e-up!.

PRODUCTION LOCATION
› Vehicle – Bratislava plant (Slovakia); powertrain – Kassel and Hanover plants; high-voltage battery – Braunschweig plant.

START OF PRE-ORDERING IN GERMANY
› September 2013.

TORSIONAL RIGIDITY
› 19.800 Nm/°.

WEIGHT
› 1,139 kg (EU kerb weight).

WHEELS
› 15-inch alloy wheels in the ‘blade’ design with 165 tyres (optimised for low roll resistance).

WORLD PREMIERE
› IAA Frankfurt, September 2013.

Innovative additional services for e-up! drivers: **Volkswagen offers complete carefree support for e-mobility launch**

Faster charging with the wall box – practical charging pack for the e-up!

'BluePower' from LichtBlick SE – CO_2-free eco-electricity for the e-up!

Free e-mobility guarantee – getting to the charging station is guaranteed

Highly trained servicing staff – 43,000 experts on electric mobility

Eight years / 160,000 km guarantee on the battery – always charged

ECO

Wolfsburg, September 2013. With the e-up! the Volkswagen brand is launching out into the world of electric mobility – and under the guiding principle of 'Think Blue' is making innovative and sustainable mobility available for all with this drive system technology as well. Naturally without any trade-offs in terms of comfort, safety, quality or driving pleasure. From the moment sales begin this autumn, around 250 specialised support operations in Germany alone will be providing people all over the country with information about the e-up! and all of the e-services that are available for the new model. Drivers of the e-up! will thus be able to start out into a highly exciting new era of motoring with no cares or concerns.

Faster charging with the wall box

Fully charged within six hours. Anyone buying an electrically powered Volkswagen can order a safe and reliable charging facility right along with the car: in cooperation with Bosch Automotive Service Solutions, Volkswagen is offering a complete package of wall box and installation. The advantage of this is that compared to charging the battery using the standard kit, doing so via the wall box takes significantly less time. With the box the high-voltage battery in the e-up! is 100 per cent recharged at a power level of 3.6 kilowatts (kW) within just six hours. Interested customers can order the wall box from their dealer. After a site inspection by a certified electrician customers are given a personal

quotation. Assuming they decide to go ahead, the wall box is delivered and professionally installed. The wall box plus installation pack is available from € 820 (in Germany). The ultimate price depends on what work is necessary at the customer's home.

'BluePower' – zero CO_2 eco-power from LichtBlick

Climate-friendly energy from hydropower. For the launch of the e-up! Volkswagen in Germany is offering the perfect electricity to go with the car. The electricity provided by the new 'BluePower' tariff is generated creating no CO_2 and comes exclusively from hydropower plants in Germany, Austria and Switzerland. The company's partners in this venture are LichtBlick SE (Hamburg) and Volkswagen Bank GmbH (Braunschweig).

'BluePower' can be ordered now from selected Volkswagen dealerships, from branches of the Volkswagen Bank and via the bank's website. The tariff consists of a monthly base rate of € 8.95 and a kilowatt/hour rate of 24.78 cents (both including VAT) and applies to the whole household supply. Customers switching to 'BluePower' receive a reward of € 30 initial credit. The contract can be terminated at any time subject to a notice period of four weeks.

The electricity's origin and quality comply with the strict criteria of the 'ok power' seal of approval from Energievision, an association sponsored by the Eco-Institute and North Rhine-Westphalia Consumer Advice. That means that at least a third of the electricity comes from hydropower plants that are no more than six years old. This ensures that further investment is continually being made in the generation of renewable energy and thus in climate protection and the switchover to new sources of power. The tariff is also certified by TÜV Nord.

In linking up with LichtBlick, Volkswagen has selected as its partner Germany's largest independent energy supplier. LichtBlick sells electricity exclusively from regenerative sources and has received numerous awards for its products, value for money and customer service. The two companies already work together on the marketing of combined heat and power plants. Together with other partners they are investigating in the INEES research project (on 'Intelligent integration of electric vehicles into the power grid for the provision of system services') ways in which pooled electricity from vehicle batteries can be used to stabilise the power grid in Germany. Eco-power tariffs for other group brands are in the pipeline.

Free e-mobility guarantee

Help in case the car gets stranded. In order to offer drivers of the e-up! greater peace of mind on longer everyday trips as well, Volkswagen is offering another special e-service: if while still getting used to the new drive system technology drivers overestimate the range and the battery becomes fully drained, they can have the car towed free of charge up to two times to the nearest Volkswagen partner, a public charging station or their home.

Highly trained service staff

43,000 electric mobility experts. The Volkswagen service centres are well equipped to support the use of electric vehicles in all large international markets. Prepared through the introduction of the Touareg Hybrid and the e-vehicle test fleet, a wide-scale network is now all set and ready for the e-up! launch. Volkswagen partners are able, for instance, to carry out all maintenance work and any repairs to the vehicles that may become necessary.

Through training mechanics and equipping the workshops with the required tools and equipment Volkswagen has ensured that customers can take their e-cars as before to the Volkswagen partner they know and trust. The Volkswagen partners have trained up selected mechanics with completed motor vehicle training as 'electrically trained' individuals. These mechanics are thus able to carry out all fundamental repairs and maintenance work on electric vehicles.

Work on the vehicle's high-voltage system is carried out by a certified high-voltage technician. In addition to basic electronics skills gained working as a fully trained motor vehicle technician, high-voltage specialists have also successfully completed extended training on electrically powered vehicles. One of the key tasks of the high-voltage technician is to disconnect the battery, so that other work, on the drive unit for example, can be carried out. At work around the world to date there are some 43,000 'electrically trained' personnel at Volkswagen partners, approximately 1,700 high-voltage technicians at 890 high-voltage support centres and 110 high-voltage experts at the Volkswagen importers.

In addition to trained staff the workshops also need special diagnosis equipment, for instance for taking measurements from the high-voltage system. For this purpose they use the compact VAS 6558A high-voltage analysis module. The device has all the necessary functions for measuring voltage levels in electric vehicles' systems. Via highly sensitive measuring techniques it is also possible to detect extremely low levels of resistance in the milli-ohm range with great precision. The module relays

the measurements via an interface to the diagnosis equipment already in place at the Volkswagen partners.

Eight years / 160,000 km guarantee on the battery

Owners of the e-up! get a guarantee on the car's high-voltage battery for eight years or 160,000 kilometres. Alongside that the existing Volkswagen warranty/guarantee period of two years with no kilometre limit applies for all faults covered by the warranty. For paintwork defects an extended guarantee period of three years applies, while the anti-perforation guarantee is for 12 years.

Further information on the subject of e-mobility at Volkswagen is available at **www.volkswagen.de/emobility**.

e-up!

e-up!		60 kW (82 PS)
Engine, electrics		
Type of engine		Permanent synchronous motor (PSM)
Continuous power	kW (PS)	40 (54)
Power output	kW (PS)	60 (82)
Max. torque	Nm	210
Battery / charging system		
Battery type		Lithium ion
Battery weight	kg	230
Battery location		between the axles
Nominal storage capacity	kWh/Ah	18.7 / 25
No. of cells / modules		204 / 17
Nom. voltage: AC/DC	V	374
Charging time: AC 2.3 kW 100% SOC	h	ca. 9
Charging time: AC 3.6 kW 100% SOC	h	ca. 6
Charging time: DC 80% SOC	h	ca. 0.5
Performance		
Acceleration 0–80/100 km/h	s	8.1 / 12.4
Top speed	km/h	130

Electrical power consumption kWh/100 km		electrical power
Combined cycle	l/100km	11.7
Emissions (CO_2)	g/km	0
Efficiency label		A+
Power transmission		
Gearbox		single-speed gearbox
Exterior dimensions		
Number of doors		4
Length/width/height	mm	3,540/1,645/1,477
Wheelbase	mm	2,420
Track, front/rear	mm	1,428/1,425
Luggage compartment		
Volume by VDA measurement: rear seat raised/folded down	l	250 - 923
Weights		
Unladen weight	kg	1,139
Permitted gross weight	kg	1,500
Payload	kg	361
Perm. axle load, front/rear	kg	780/750
Driving range		
According to NEDC	km	160
In summer operation	km	120 - 165
In winter operation	km	80 - 120

SMILE

IMAGE SOURCES

WWW.PHOTOCASE.DE: Page 08: maiwind / Page 09: samkuem / Page 83: läns

WWW.VOLKSWAGEN-MEDIA-SERVICES.COM

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